THE FORMAL GARDEN.

MISSOURI

BOTANICAL GARDEN.

NINETEENTH ANNUAL REPORT.

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PUBLISHED BY THE BOARD OF TRUSTEES.
1908.

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A. D. CUNNINGHAM, Secretary

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*Ex-Officio.

[1] Elected President of the Board of Public Schools of St. Louis in October, 1908, to succeed Frank L. Magoon, who had held that office for one year.

[2] Elected Chancellor of Washington University in October, 1908, to succeed Winfield S. Chaplin, who held that office from October, 1891 until October, 1907, the office being vacant during the past year.

Ref. 580.7

PREFACE.

Under direction of the Board of Trustees, the nineteenth annual report of the Missouri Botanical Garden is presented to the public.

The eighteenth report was issued December 7, 1907, but Professor Blankinship's account of Lindheimer and his collections was separately distributed on November 25th, and separates of the other scientific papers contained in the volume were issued on the 27th of November.

These reports are sent to scientific institutions and journals, in exchange for publications and specimens desirable for the library, herbarium or living collections of the Garden. So far as is possible, reprints of the botanical articles they contain are sent to botanists occupied with a study of the subjects to which they pertain.

Any of the Garden publications not out of print may be purchased, at approximately the cost of publication, from Mess. R. Friedländer & Sohn, Berlin, Germany; W. Wesley & Son, London, England; or the undersigned.

WILLIAM TRELEASE.

ST. LOUIS, MO., Sept. 25, 1908.

THE WILD GARDEN.

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REPORTS FOR THE YEAR 1907.

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REPORT OF THE OFFICERS OF THE BOARD.

SUBMITTED TO THE TRUSTEES JANUARY 8, 1908.

To the Board of Trustees of the Missouri Botanical Garden:

We submit for your consideration the financial results for the year ending December 31st, 1907.

We are gratified to announce that the results for the past year have been entirely satisfactory and the rental earnings, our principal source of revenue, were $5,602.33 in excess of the previous year.

That portion of the Board property east of Fourth Street has steadily appreciated in value for rental purposes, and the rental income is greater than at any time within the past twenty years.

All of our property lying west of Fourth Street is constantly increasing in value, and we estimate a further increase of $4,600 in rentals for 1908 over those of the past year.

Our loss in income from vacancies for the year was only $532.37, and at present all of our buildings are rented with the exception of a few small tenements renting in all for $75.00 per month.

We purchased during the year a small piece of property fronting on the Levee between Vine Street and Washington Avenue, 23×90, situated between property already owned by the Board, at a cost of $5,500, which we at once leased at $600.00 per year.

We have disposed of only two pieces of property, in all 127 feet, fronting on Flora Avenue, at an average of $78.00 per front foot. The demand for first-class residence property on the south side has fallen off considerably on account of the high prices for building material and labor.

We have had several inquiries for large tracts of unimproved

property, but the offers were so far below our estimates of value, that they were declined.

The matter of special taxes for streets and sewers is and will be for some years a serious hindrance to contemplated and much needed improvements at the Garden, such as the erection of plant houses and an addition to the library and office building.

Some of the street improvements anticipated in our last report have been completed and paid for out of our revenue and savings, and the following amounts have been charged to real estate as betterments:—

Sidewalks	McRee Ave.	$ 528 53
Paving street	Vandeventer Ave	1,867 46
Paving street and sidewalks	Spring Ave.	14,452 34
Paving street and sidewalks	Tower Grove Ave	28,505 08
Sewer	Spring Ave.	654 05
Sewer	City Block 2835	402 01
Total		$46,409 47

The following street improvements are either completed or under way, and must be paid for during 1908:—

Old Manchester Road	$17,500 00
Thurman Ave.	1,763 79
McRee Ave.	3,150 00
	$22,413 79

The following amounts have been credited to the Stock Account for the year:—

Library	$4,783 73
Herbarium	5,381 40
	$10,165 13

The annual bequests provided for in Mr. Shaw's will have been carried out at a cost of $2,277.94.

By his resignation of the Chancellorship of Washington University in October last, Dr. W. S. Chaplin withdrew from the membership in this Board which he had held *ex officio* since October 1891. With our regret at the severance of this long official association, we take this occasion to record

our high appreciation of Dr. Chaplin's conscientious faithfulness in bearing a full share of our responsibilities during the past sixteen years, and of his strong manly character.

RECEIPTS.

Receipts on account of rental		$130,416 58
Interest and dividends		3,542 99
Garden pasturage above expenses		124 94
Garden handbook sales		184 00
Publication sales		3 75
Library sales		5 00
Total income receipts		$134,277 26
Sales of real estate under decree of court	$ 5,620 00	
Shaw School of Botany, rent	3,900 00	
Stocks, bonds and certificate	26,563 06	36,083 06
Total receipts		$170,360 32
Cash on hand, December 31, 1906		7,731 04
		$178,091 36

DISBURSEMENTS.

Garden Account,		
Labor pay-roll	$20,013 07	
Students' pay-roll	1,486 03	
Office assistance	1,575 00	
Fuel	2,255 19	
Water	382 00	
Repairs and supplies	2,062 66	
Plants and seeds	501 12	$28,275 07
Herbarium Account,		
Salaries	942 84	
Fuel	127 32	
Current expenditures	1,952 64	3,022 80
Library Account,		
Salaries	2,730 72	
Fuel	165 73	
Current expenditures	2,227 15	5,123 60
Office Account,		
Salaries	5,227 65	
Fuel	205 77	
Current expenditures	464 98	5,898 40
Research Account,		
Salaries	1,748 10	
Current expenditures	609 97	2,358 07
Carried forward		$44,677 94

Brought forward		$44,677 94
Scholarship Account,		
Instruction	675 00	
Care of Lodge	240 00	
Fuel	88 20	
Current expenditure	88 34	1,091 54
Total maintenance		$45,769 48
Garden Improvement Account,		
Director's residence		1,224 17
Total amount expended on the Garden		$46,993 65
Publication Account,		
Eighteenth annual volume	2,004 67	
Ninth annual volume, reprint	318 20	
Tenth annual volume, reprint	340 50	
Garden Handbook	21 04	2,684 41
Property Account,		
State, school, city and sprinkling taxes	38,932 72	
Streets, sidewalks and sewers	48,323 52	
Insurance	4,788 31	
Repairs	7,130 76	
Improvements	3,561 95	102,737 26
Office Expenses,		
Salaries	4,200 00	
Office rent	780 00	
Printing, advertising, telephone, etc.	693 50	5,673 50
Bequests,		
Annual Flower Sermon	200 00	
Annual Flower Show	465 00	
Annual Gardeners' Banquet	393 59	
Annual Trustees' Banquet	1,219 35	2,277 94
Sundries,		
Legal and professional expenses	1,103 75	
Commission	115 50	
Repairs to building damaged by fire	150 00	
Real estate	5,500 00	
Shaw School of Botany, rent	3,838 25	10,707 50
Total disbursements		$171,074 26
Cash on hand December 31, 1907		7,017 10
		$178,091 36

Respectfully submitted,

R. J. LACKLAND, President.

Attest:

A. D. CUNNINGHAM, Secretary.

TRIZEUXIS FALCATA.

NINETEENTH ANNUAL REPORT OF THE DIRECTOR.

SUBMITTED TO THE TRUSTEES JANUARY 8, 1908.

To the Board of Trustees of the Missouri Botanical Garden:

The following report on the Missouri Botanical Garden and the School of Botany connected therewith is respectfully submitted in compliance with the rules of the Board:—

GARDENING.

The area devoted to decorative planting being essentially unchanged, the number of individual plants used remains nearly the same from year to year. The parterre was again used in the early spring of 1907 for tulips, of which, here and elsewhere, 21,500 plants, representing nearly 200 varieties, were grown: an increase of 2,500 over the previous year. During the summer, the same ground was occupied by zonal and hybrid pelargoniums, of which 22 varieties were presented in contrasted masses, which aggregated 3,500 plants. As with tulips, this selection was supplemented in the customary manner by a much larger number of varieties of the same kind of plants grown elsewhere, but represented by a smaller number of individuals—the pelargoniums so grown numbering 2,250, including 212 named species or varieties. The other bedding features of the Garden have been maintained essentially as in immediately preceding years, but by the use of different plants. The most marked change was in the beds flanking the entrance walk and surrounding the parterre, where a simple fleur-de-lis design was worked out in *Alternanthera, Peristrophe, and Santolina.* The total number of bedding plants used in the Garden, aside from tulips, was 37,500.

Chrysanthemums were again grown in quantity, and through the fortnight beginning with November 4th, 4,000 choice plants, representing 400 varieties, were displayed under canvas in the parterre. As was the case last year, I desire

to record my most appreciative thanks for the aid rendered by Captain Robert McCulloch, of the United Railways Company, who kindly installed and maintained electric lights in the tent during the time that the chrysanthemums were on view, which again enabled me to open the tent to visitors in the evening. This season, the weather proved perfect during the time that the chrysanthemums were exhibited, and visitors for the fortnight numbered 33,521, of whom 8,601, or over one-fourth, came in the evening.

Plant and seed accessions for the year, aside from Garden propagations and collections, number 274, comprising 12,655 plants or packets of seeds. Of these, 6,859, representing 230 of the accession entries, and valued at $605.35, were presented or received in exchange for similar material or for Garden publications, and 5,796, representing 44 entries, were purchased, the Secretary's books showing an expenditure of $501.12 for such purchases, including transportation and other charges. The collections by Garden employees, exclusive of seeds for exchange purposes, number 1,726 plants, valued at $123.86, and 51 packages of seeds, valued at $3.50. Garden propagations amounted to 47,225 plants, valued at $3,305.75, in addition to 7,665 seedlings, valued at $383.25.

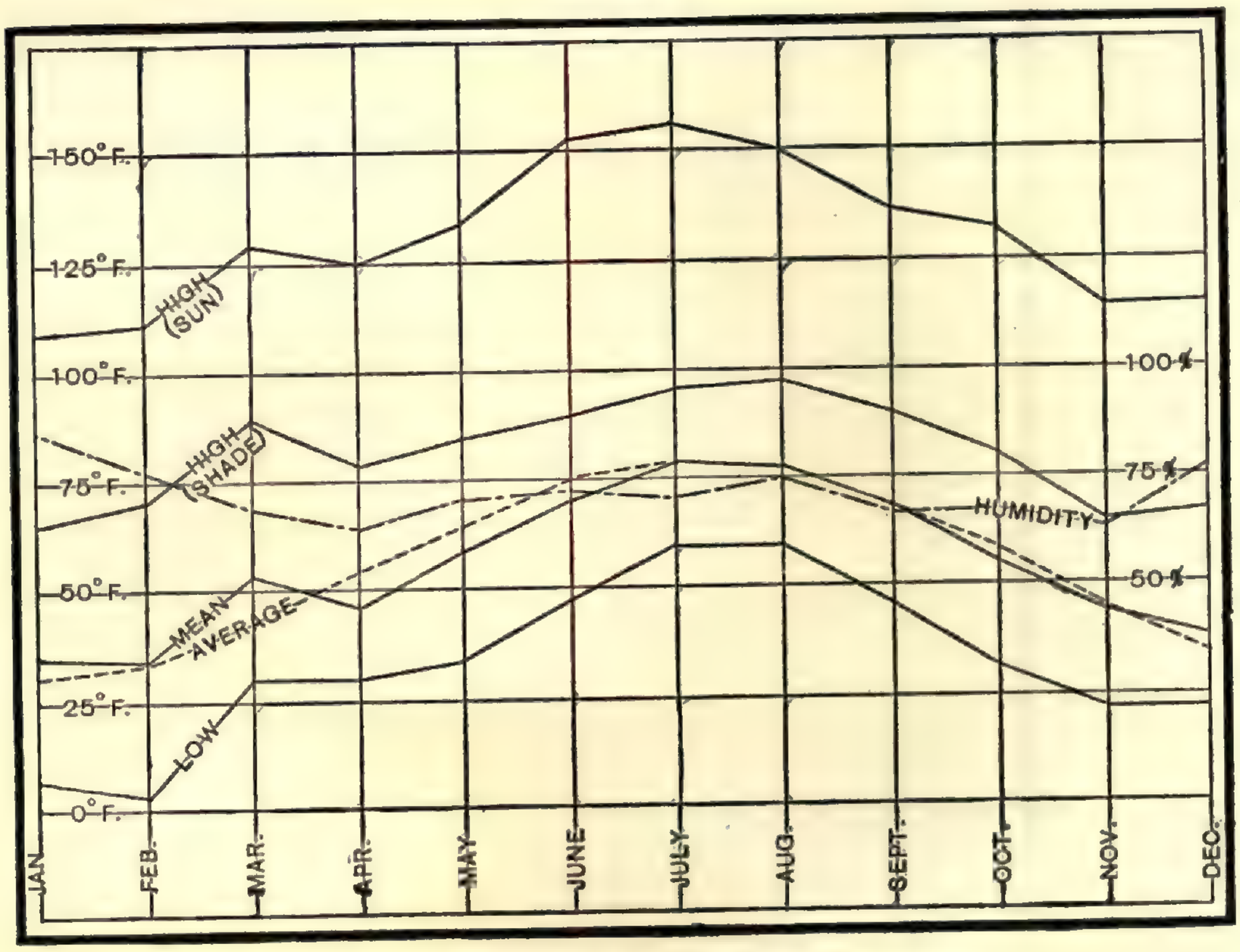
The exchange list issued by the Garden last winter included 1,519 species or varieties; and 5,686 packets of seeds, valued at $284.30, selected from this list, have been issued to correspondents. Living plants to the number of 4,612 (of which 4,000 were bulbils of henequen), valued at $145.55, have also been distributed to correspondents. In addition to these exchange distributions, 747 duplicate plants from the Garden collections have been presented to schools and colleges for educational use, and 1,300 bedding plants removed from the grounds at the approach of winter, or remaining after the beds had been planted in the spring, were placed in the kindergartens and playgrounds of the city schools. The surplus of chrysanthemum plants which were still usable when removed from the tent, together with many cut flowers, were distributed to hospitals and similar charities. The total number of plants so distributed through the year amounts to 642.

The records show that 1,502 species or varieties were added to the collection of living plants in 1907, and that 658 were lost or discarded, leaving a net gain of 844; the total reported at the end of the year being 17,916, as compared with 17,072 noted for 1906.*

THE WEATHER.

The accompanying diagram A graphically presents the monthly variation in temperature as derived (except for

DIAGRAM A.



TEMPERATURE. HUMIDITY.

the solar maximum) from the records of the local office of the Government Weather Bureau; and diagram B shows the distribution of rainfall through the season, as indicated by the same records. The most striking deviations from earlier averages are found in the marked warmth of the last week in March, when the temperature was that of early summer, and

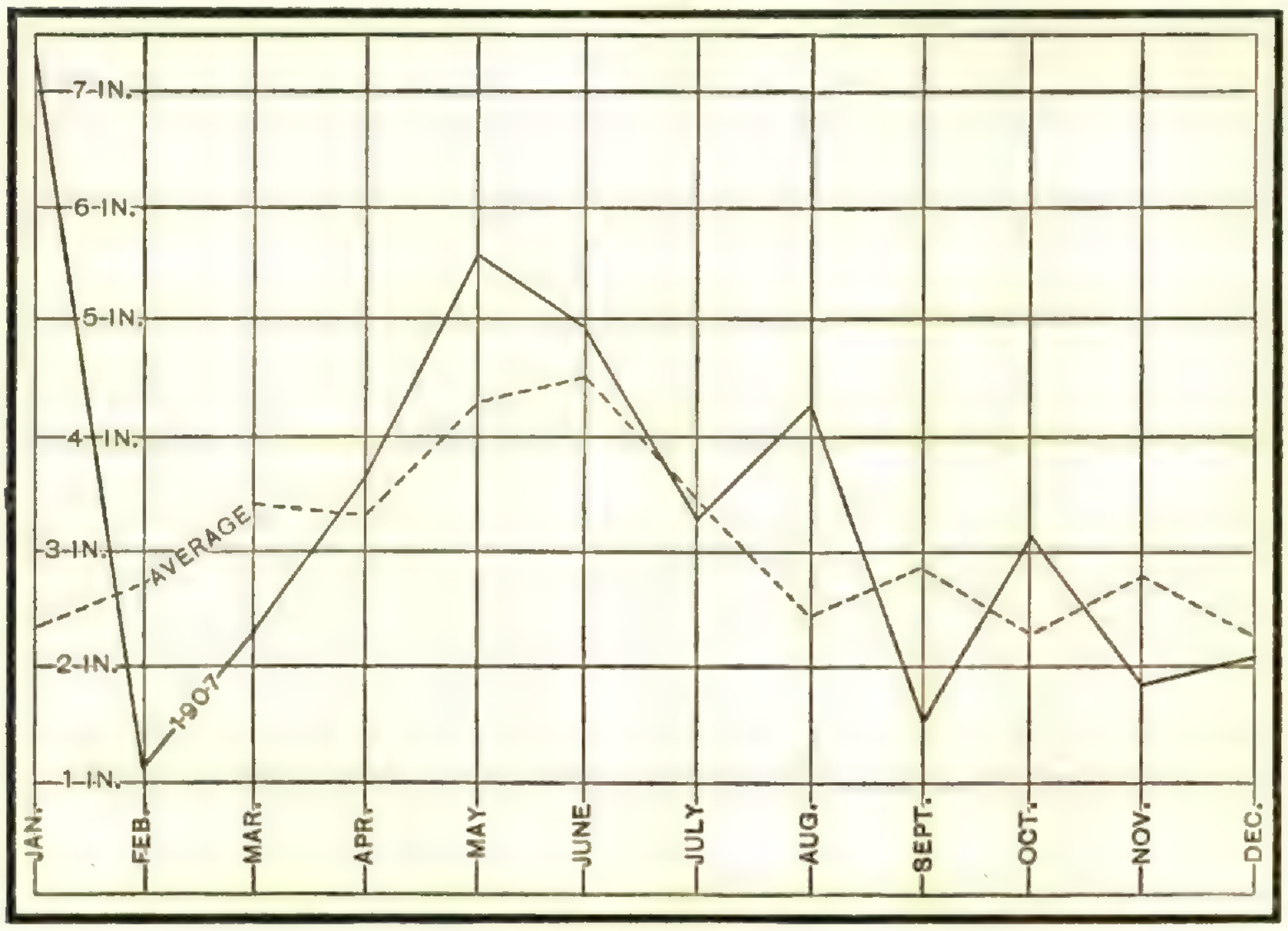
* Rept. Mo. Bot. Gard. 18: 15.

the very heavy precipitation in January, followed by a slight drought in February and March. The average temperature through the summer was almost exactly the summer average for the period covered by Government records.

VISITORS.

Except during the World's Fair, there has been no year in which so many people have visited the Garden as during the past season, the number being 135,497. Of this total, 26,114

DIAGRAM B.

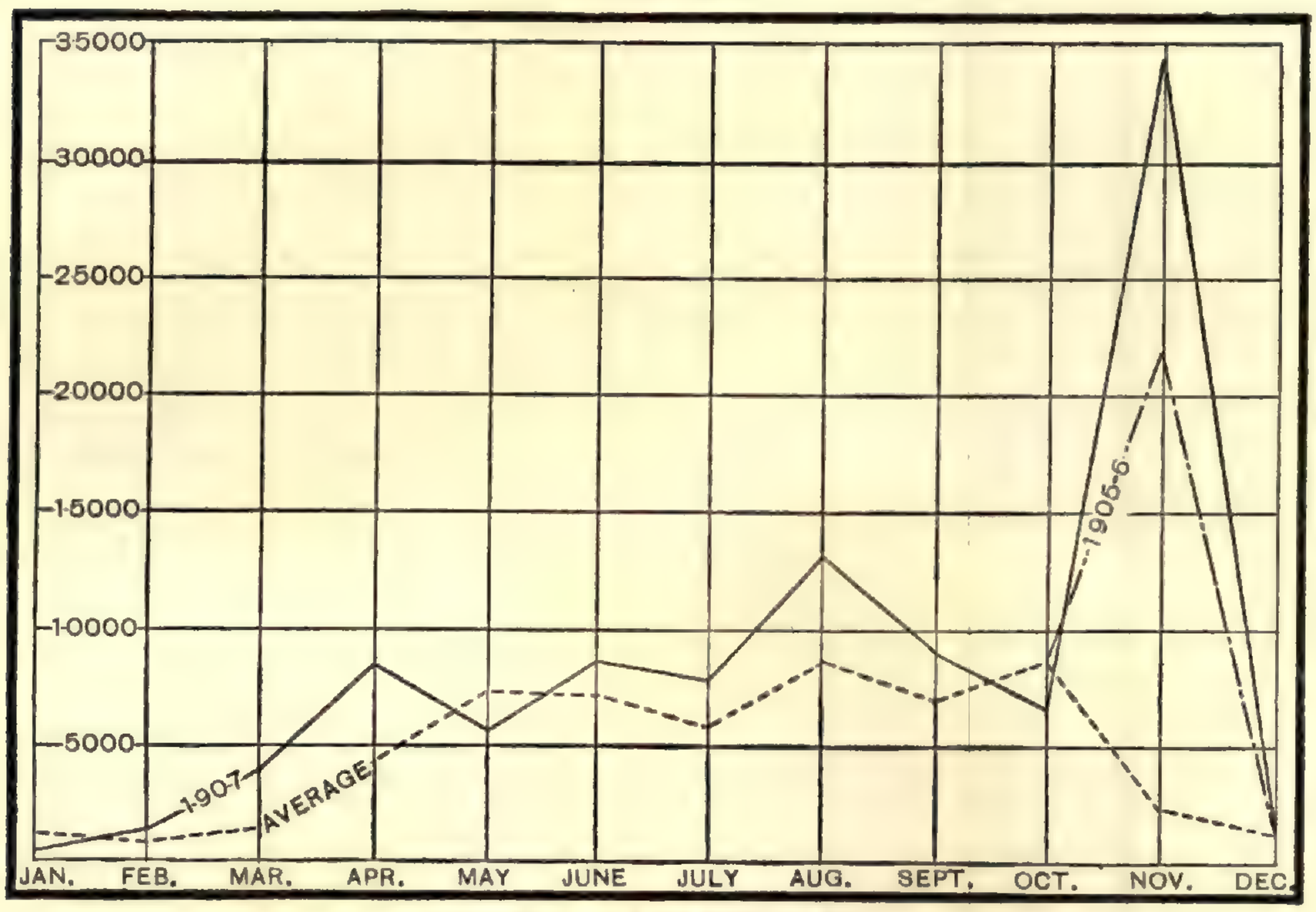


PRECIPITATION.

were recorded for the open Sunday afternoon in June, and 10,093 for the corresponding Sunday afternoon in September, which was very hot and sultry, the remaining 99,290 being week-day visitors. As for several years preceding, an unusually large number of persons were attracted in March and April by the tulips, and in November by the chrysanthemums, the November visitors this year amounting to 34,439, or something over one-third of the week-day total for the year.

The appended diagram C shows the seasonal distribution of week-day visitors contrasted with the average for earlier

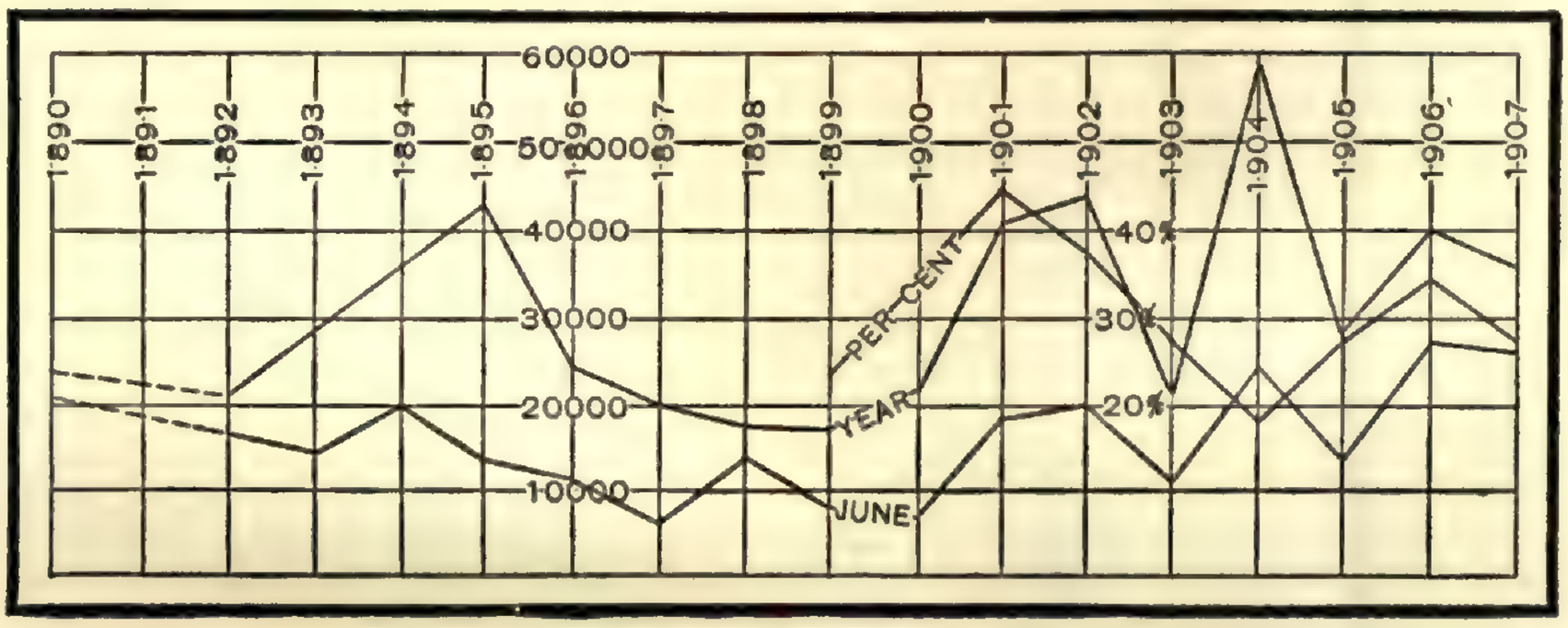
DIAGRAM C.



VISITORS ON WEEK-DAYS.

years since records have been kept (excepting the Exposition year, 1904).* The lower November average on this diagram,

DIAGRAM D.



SUNDAY VISITORS.

which may be taken as normal to this season of the year, is also exclusive of the years 1905 and 1906, in which the

* Rept. Mo. Bot. Gard. **16**: 18.

display of chrysanthemums likewise greatly increased the number of visitors—their average for these two years being indicated separately by a broken line.

The relation of Sunday visitors, who this year amounted to 26.7 per cent. of the total, to week-day visitors, is graphically shown on diagram D. During the year, 736 copies of the little Handbook of the Garden were bought by visitors, exhausting the edition placed on sale at the beginning of 1905, and necessitating the issuing of a new and revised edition.

THE HERBARIUM.

The established practice of purchasing current collections for the herbarium has been continued, and advantage has been taken of a number of opportunities to secure useful small herbaria at various times through the year. Among the more important specimens that have been incorporated are the remainder of the Reverchon* herbarium (11,401 sheets), a representative series of duplicates from the Gandoger† herbarium (7,591), a portion of the Fink ‡ herbarium (3,450), Dr. Hedgcock's herbarium (1,411), Lindheimer's¶ collections of 1849-1851 (1,317), Pitard's Canary Islands plants (925), and nearly 1,000 specimens, mostly Mexican, collected by Dr. Edward Palmer.

The incorporated additions for 1907 amount to 35,876 sheets of specimens, of which 3,706, valued (unmounted) at $185.30, were presented or received by way of exchange; 603, valued at $30.15, were collected by employees; and 31,567 were acquired by purchase, the expenditure for such specimens and material, shown by the Secretary's books, being $1,952.64.

Among the unincorporated material forming a part of the Engelmann herbarium§ were some 20,000 specimens of Texan plants collected by Ferdinand Lindheimer between 1849 and 1851. These have now been named, and a full set in duplicate deposited in the Garden herbarium. The

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* Rept. Mo. Bot. Gard. **18**: 18.
† Rept. Mo. Bot. Gard. **17**: 33.
‡ Rept. Mo. Bot. Gard. **17**: 33.
¶ Rept. Mo. Bot. Gard. **18**: 159.
§ Rept. Mo. Bot. Gard. **1**: 62, 93. **2**: 24. **3**: 15.

residue have been made up into 39 sets for distribution to the principal herbaria of the world, where, being especially rich in typical illustration of the Texan flora, they will prove of much value.

The herbarium, so far as now mounted, consists of:—

The Engelmann Herbarium (all groups)		97,859 specimens.	
The General Herbarium:—			
Higher plants.			
The J. J. Bernhardi Herbarium .	61,338		
The Henry Eggert Herbarium* .	23,495		
The J. H. Redfield Herbarium .	16,447		
The Sturtevant and Smith Herbarium	7,446		
The Gustav Jermy Herbarium .	4,789		
The A. W. Chapman Herbarium*	3,536		
The Julien Reverchon Herbarium*	17,210		
The Nicholas Riehl Herbarium .	3,359		
Other specimens	312,065	449,682	"
Thallophytes.			
The J. J. Bernhardi Herbarium*	610		
The Gustav Jermy Herbarium .	1,659		
The S. M. Tracy Herbarium* . .	4,312		
The Wm. Trelease Herbarium .	11,000		
Other specimens	30,021	47,602	"
Making a total of		595,143	"
Valued at		$89,271 45†	

Supplementing the herbarium, and the shelved or incorporated exsiccatae, which are here counted as a part of it,‡ the Garden possesses specimens of economic plant-products, woods, seeds, etc., valued at $175.00, and 1,851 preparations for microscopic study, valued at $410.00, which have not been added to since their enumeration in my last report.§

THE LIBRARY.

Though no standing appropriation for the purchase of books has been available, the maintenance allowance has sufficed for more important current publications, and special

* So far as yet incorporated.

† This valuation at the rate of $15.00 per hundred mounted sheets.

‡ Rept. Mo. Bot. Gard. **16**: 21. § Rept. Mo. Bot. Gard. **18**: 20.

appropriations have made it possible for me to secure the rare Seville edition, of 1535, of Oviedo's Historia General de las Indias, as well as several of the early publications of De Laet and others on the West-Indian region.

The list of biological serial publications represented in the libraries of St. Louis, to which reference has been made in earlier reports,* is now said by the librarian to be ready for publication; and, as it promises to be helpful to local workers, I trust that it may be printed in the course of the present year. As in 1906, in addition to caring for current accessions and working on this list, the cataloguers have been occupied with a general shelf revision of the library, and during the year 7,226 of the catalogue cards have been replaced by new and verified cards.

Additions number 947 books, valued at $1,612.25, and 2,116 pamphlets, valued at $357.65, presented or received in return for Garden publications; and 233 books and 40 pamphlets bought, the expenditure for purchases and binding amounting to $2,227.15.

The card index has been enlarged by the addition of 58,668 cards, of which 47,148 were written by employees, the remainder being purchased. Special attention has been given to indexing plant illustrations, and the literature of floral ecology and germination, the librarian's hope being that the entries referring to the last-named subject, which are already some 52,000 in number, may eventually be published in the form of a detailed bibliography.

The serial publications now received number 1,416, of which 99 are bought, and 1,317, issued by 935 institutions or publishers, are received in exchange for the Reports of the Garden. This number is 57 larger than that reported last year.

As now constituted, the library contains:—

Pamphlets	33,735			
Books	24,421			
	58,156	valued at		$86,597 78
Manuscript volumes	77	"	"	910 00
Total	58,233	"	"	87,507 78
Index cards	629,921	"	"	6,299 21
Total valuation of library				$93,806 99

* Rept. Mo. Bot. Gard. **17**: 36. **18**: 20.

ONCIDIUM IRIDIFOLIUM.

RESEARCH AND THE USE OF FACILITIES.

Under the fixed policy of administration, a number of Garden employees have given such time as could be spared from necessary maintenance duty to research work, some of the results of which have been published in the last volume of the Garden Report, or are in course of preparation for publication. It was my own privilege, early in the year, to spend two months in a field study of the Agaves of certain of the West Indies, the results of which are now being brought into form for publication.

The engagement of Professor Blankinship, reported a year ago,* made possible a long delayed study of the enormous mass of herbarium material collected in Texas by Ferdinand Lindheimer between 1849 and 1851, which came to the Garden many years ago as a part of the Engelmann herbarium. Supposed at first to represent duplicates, these specimens were found to be actually unnamed plants intended for sale to the subscribers to Lindheimer's "Flora Texana Exsiccata" of sixty years ago, with few exceptions unrepresented in collections, and even lacking from Engelmann's own herbarium. To their study, Dr. Blankinship has brought a conservative spirit consonant with that of the great botanists Engelmann and Gray, whose publications on Lindheimer's earlier collections have given them classic value; and his recently published paper on this later material† is enriched by an authentic and appreciative sketch of Lindheimer, the collector, whose earlier known work has also been correlated with that which is now first made known.

As in earlier years, the facilities of the Garden have been freely placed at the disposal of visiting botanists, and the usual loans have been made and office assistance rendered to those who were unable to come to St. Louis for study. Perhaps the most important use to which the Garden has yet been put by visitors was a study of transpiration, comparative with results reached in the desert regions, to which

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* Rept. Mo. Bot. Gard. **18**: 22.

† Rept. Mo. Bot. Gard. **18**: 123.

Dr. Burton E. Livingston of the Carnegie Institution devoted some two months of residence in the late winter and early spring.

THE HENRY SHAW SCHOOL OF BOTANY.

At the end of the last college year, Mr. A. C. Life, who had served efficiently as Instructor for three years, resigned his position to accept an appointment in the University of Southern California. The vacancy so created has been filled by the appointment of Mr. W. A. Ruth as Assistant in the School of Botany.

A re-arrangement has been made of the electives offered to undergraduate students,* the present courses, in addition to a joint course in biology, being announced in the University Catalogue as follows:

1–2. Botany: Elementary Morphology and Organography. Laboratory work, with supplementary lectures and quizzes, dealing with the form and structure of plants, with special reference to their life processes, including ecological adaptations, and to Systematic Botany.

Students who have taken Courses 1 and 2 may join the field excursions in a subsequent spring, for advanced ecological study counting for a credit of 1 unit. In such cases a thesis will be required of the student upon a topic assigned by the instructor.

4. Plant Relations: Lectures, with demonstrations, on the vegetable kingdom: Dealing with the structure and physiology of plants, their relations to environment, past history, variation, heredity, evolution, economic uses, etc. Second term, twice a week. 1 unit. Open to all classes.

5–6. Plant Physiology, including Ecology. Laboratory work, with supplementary lectures.

7–8. Cytological Technique. Laboratory work in the cultivation and examination of bacteria and the methods of histological investigation, combined with a study of the principal types of plant anatomy—specially adapted to the needs of students intending to study medicine.

9–10. Systematic Botany. Laboratory and field work, with supplementary lectures, dealing with the comparative structure and the classification of plants.

11–12. Plant Pathology and Applied Mycology. Laboratory work.

The enrollment for the first term of 1907-8 was:—" Biology 1," 10; " Botany 1," 6; " Botany 5," 12; " Botany 7," 2;—

* For comparison see Rept. Mo. Bot. Gard. **17:** 38.—Unless otherwise noted, each course is entitled to a College credit of 3 units.

a total of thirty students, of whom the ten first noted give about equal time to botany and zoology, the others taking one full botanical course each. Though not so large as two years ago, this enrollment is slightly larger than that of last year.

At the 1907 Commencement of Washington University, the degree of Master of Arts was conferred on Miss Anna E. Tensfeld, for work in botany. It may be proper to note that at this anniversary Commencement, the honorary degree of Doctor of Laws was conferred on the Director of the Garden, who has also been the responsible head of the School of Botany since its establishment in 1885.* There are now registered at the University one candidate for the Master's degree, and one for the Doctor's degree, with botany as a major study.

GARDEN PUPILS.

In March, Mr. Shelby C. Jones and Mr. George D. Schulte, who had completed the course and passed an examination satisfactory to the Garden Committee, were given the customary certificate. On the results of competitive examination, duly announced, the scholarships which had been held by Mr. Federer, whose resignation was reported a year since, and Mr. Jones, were awarded to Mr. Arthur H. Smith, of Marshalltown, Iowa, and Mr. Raymond B. Wilcox, of Waterloo, Wis., and, on nomination of the Missouri Horticultural Society, the remaining scholarship was granted to Mr. Jesse B. Tuggle, of Parkville, Mo. In August, Mr. Paul Roper, who had held a scholarship on the nomination of the St. Louis Florists' Club since October 1, 1904, relinquished it, to return to his home, and on nomination of the same Club the scholarship was re-awarded to Mr. Edwin Nyden, of Kenosha, Wis.

No change has been made during the year in the teaching staff or the prescribed course of study; but in October the Board recorded its appreciation of the unsolicited action of the Corporation of Washington University in opening its courses in entomology, without payment of tuition, to

* Rept. Mo. Bot. Gard. **1**: 59.

Garden pupils, several of whom have availed themselves of the privilege thus afforded of doing extra work in the College.

THE GARDEN STAFF.

Aside from a reduction in the number of persons temporarily employed in both library and herbarium, the only changes in the salaried office force to be reported are the engagement, in the latter part of the year, of Professor Moses Craig as Herbarium Assistant, to succeed Professor J. W. Blankinship, who had held the post for a year; and the appointment, early in the season, of Miss Isadore Smoot as Library Cataloguer, to fill the vacancy reported last year.

In June, the post of Plant Pathologist, created by the Board, was filled by the honorary appointment to that office of Dr. Hermann von Schrenk, who entered upon it on the first of the succeeding month, and has since devoted to the study of plant diseases such part of his time as could be spared from his professional engagements as a timber expert.

SPECIAL TESTAMENTARY PROVISIONS.

All of the annual events explicitly provided for by the will of Mr. Shaw have taken place in 1907.

The flower sermon was preached in Christ Church Cathedral, St. Louis, on the morning of May 12th, by the Right Reverend Robert Strange, Bishop of East Carolina.

The Trustees' banquet was given at the Southern Hotel, St. Louis, on the evening of November 30th, 1907, this date being selected because there were then meeting in St. Louis the Central Association of Science and Mathematics Teachers and the Southwestern Section of the American Mathematical Association; a large proportion of the 181 guests were representative of these two associations. Bishop Tuttle presided, and speeches appropriate to the occasion were made by Professor C. M. Woodward, of Washington University, Professor C. A. Waldo, of Purdue University, Professor H. E. Slaught, of the University of Chicago, Professor E. R. Hedrick, of the University of Missouri, and Honorable C. P. Walbridge, of St. Louis.

The eighteenth gardeners' banquet was given at the Southern Hotel, on the evening of August 14th. One hundred and thirty-five guests were seated, of whom about one-half were members of the American Apple Growers' Congress, which was then meeting in St. Louis. The Director of the Garden presided, in accordance with the direction of Mr. Shaw's will. On the conclusion of the dinner, appropriate speeches were made by President H. M. Dunlap, of the American Apple Growers' Congress, Honorable Philip C. Scanlan, Park Commissioner of St. Louis, Professor M. B. Waite, of the United States Department of Agriculture, Honorable Norman J. Colman, Ex-Secretary of Agriculture, Mr. Walter Retzer, of St. Louis, President L. A. Goodman, of the American Pomological Society, and Chairman J. C. Vaughan, of the National Council of Horticulture.

The premiums designated for a flower show were this year awarded through the St. Louis Horticultural Society, at an exhibition held in the week beginning with November 11th. The awards included a gold medal* to Mr. W. A. Manda for his introduction of *Dracaena Mandaiana*.

Very respectfully,

WILLIAM TRELEASE,

Director.

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* Rept. Mo. Bot. Gard. **5**: 18. **9**: 19. **11**: 20. **16**: 29.

SCIENTIFIC PAPERS.

THE FLORIDA STRANGLING FIGS.

BY ERNST A. BESSEY.

The genus *Ficus*, in particular the section *Urostigma*, contains many species that have, in their earlier stages, a tendency to assume the epiphytic habit. This is the case, according to Engler,* with *F. elastica* Roxb., *F. bengalensis* L., less often with *F. infectoria* Roxb. and still more rarely with *F. religiosa* L. In Mexico, as described by Trelease,† a species doubtfully referred to *F. ligustrina* K. & B., but, as Dr. Trelease informs me, held by Warburg to be rather *F. radula* or a closely allied undescribed species, is abundant as an epiphyte upon *Sabal mexicana*, the plants becoming eventually self-supporting on their trunk-like roots.

There are two native species of figs in Florida: *F. aurea* Nutt. and *F. populnea* Willd. Under circumstances both may exhibit the epiphytic habit when young, although the latter species shows the characteristic only rarely. So far the writer has observed it as an epiphyte only once, upon *Quercus virginiana* Mill. He has observed *F. aurea* upon the following trees, the first two being the most common hosts: *Quercus virginiana* Mill. (plate 1), *Sabal palmetto* (Walt.) R. & S. (plate 2), *Metopium metopium* (L.) Small (plate 4, fig. 1), *Bursera simaruba* (L.) Sarg., *Coccolobis laurifolia* Jacq., *Gymnanthes lucida* Sw. (plate 5, fig. 1), *Dipholis salicifolia* (L.) A. D. C., and even on large trees of its own species (plate 4,

* Engler & Prantl. Die natürlichen Pflanzenfamilien. III. 1: 89-92. (1888).

† Trelease, Wm. Illustrations of a "Strangling" Fig Tree. Sixteenth Annual Report of the Missouri Botanical Garden. 161-165. Pls. 34-45. (1905).

fig. 2). In dense hammocks *F. aurea* seems to grow only as an epiphyte at the start, although eventually all trace of this habit is lost. In open places, however, it is often independent from the first (plate 3). It is often set out as a street or yard tree in Miami (plate 5, fig. 2). Such trees have a single upright true trunk and rounded head, and are rather ornamental at first. Eventually, however, they begin to send down rootlets from their branches. These, upon taking root, enlarge rapidly, so that the local name for the tree, wild banyan, is not at all inappropriate. The trees that start epiphytically usually arise from seeds that lodge in knotholes (plate 4, fig. 1) or crotches of branches, or the axils of the palmetto leaves, probably through the agency of birds, as these are very fond of the fruits. The young seedlings grow slowly at first. Soon the roots begin to elongate rapidly, remaining of small diameter and growing downward in close contact with the bark or even swinging loosely. Only when the roots have established connection with the ground does the growth of the plant become rapid. The roots then increase in thickness very rapidly and new roots are sent down. These anastomose wherever they come into contact, forming a close network around the trunk of the doomed supporting tree. Soon the thickening roots close up all the holes, making a firm tube enclosing the trunk of the host and killing it very soon by preventing growth in thickness, *i.e.* practically girdling it for a long distance up and down the trunk. The palmetto is an exception, however, for, since the stem does not increase in thickness, it suffers no immediate inconvenience and may remain alive for years after its trunk is firmly encased by the fused roots. Eventually, however, it will be so overtopped and shaded by the *Ficus* that it dies, but this may not be for many years. In old age a tree of *Ficus aurea* will have many root trunks and may have a spread of 25 meters or even more, and a height of over 15 meters.

Both *F. aurea* and *F. populnea* have two or more crops of fruits in a year. In the former species the receptacles are sessile, in pairs in the leaf axils (plate 6), in the latter they are long stalked, single or in pairs (plate 7). Both species belong to the section *Urostigma*, and have staminate and seed

and gall producing pistillate flowers in the same receptacle, the receptacle being axillary to the smooth, entire leaves. The staminate flowers have but one stamen. Each flower is subtended by a small bract while several rows of bracts surround the opening of the receptacle. The staminate flowers are scattered among the others and do not come to maturity until the fruit is ripe. Pollination is accomplished by species of *Blastophaga*, different in the two figs. These reach maturity with the seeds at the time that the receptacle is about to begin to ripen pomologically. Just at this time the staminate flowers reach maturity so that the pollen is shed while the insects are emerging from the galls. The fecundated females become covered with pollen in their search for the point of exit from the mature receptacle. They seek out the young receptacles in which the pistillate flowers are just ready for pollination. Usually but one, occasionally two insects enter a receptacle, losing their wings as they force their way between the outer scales which surround the opening. These scales are appressed tightly in several series but loosen up at the time when the flowers are ready for pollination, permitting the *Blastophaga* to force her way between them with not too much difficulty. As the insect works around over the flowers in the act of depositing her eggs she leaves on the receptive stigmas the pollen adhering to the hairs that cover her body and appendages. But one egg is laid in each flower, the ovipositor apparently being inserted down the hollow of the style, the egg being placed in the upper part of the ovary upon the top of the ovule, where it was observed in several cases. Counts were made in several mature receptacles of both species to determine the number of flowers in which *Blastophaya* larvae developed and of those developing seeds. This is shown in the accompanying tables:

TABLE A.

No.	Seed flowers.	Gall flowers.	Per cent. female flowers with galls.	Staminate flowers.	Per cent. staminate among all flowers.
1	125	103	45	.....	.....
2	112	117	51	.....	.....
3	79	104	57	.....	.....
4	39	101	72	21	13
5	45	87	66	14	8.4

FICUS AUREA.

TABLE B.

No.	Seed flowers.	Gall flowers.	Per cent. female flowers with galls.	Staminate flowers.	Per cent. staminate among all flowers.
1	148	230	66	54	12.5
2	114	247	68	73	17

FICUS POPULNEA.

In many species of *Ficus* there are two types of pistillate flowers, one producing seeds, the so-called seed flowers, and the other present only to receive the *Blastophaga* eggs, one in each flower, producing the *Blastophaga* galls, the so-called gall flowers. These gall flowers require the stimulus of the egg to cause them to develop further. Otherwise they degenerate, as they are incapable of producing seeds. Careful study of the flowers shows that this distinction does not exist in the species under consideration. It is indeed a fact that two extremes of the pistillate flowers may be distinguished—those with long and those with short styles (plate 8, figs. 1-3, *F. aurea;* 8-9, *F. populnea*). This is correlated with the length of the flower pedicel so that all the stigmas occupy the same level. The difference in length of the pedicels seems to be an arrangement permitting the flowers to be present in two layers instead of in merely one. There are many intergradations, however, between the two extremes (plate 8, fig. 2).

It is a fact that the long-stalked, short-styled flowers are preferred by the ovipositing *Blastophaga*, for only rarely can one find more than one or two such flowers producing seeds, they being usually occupied by *Blastophaga* larvae (plate 8, fig. 7). However the fact that such flowers of this type as escape oviposition do develop perfect seeds demonstrates that they are not specialized gall flowers. Furthermore, of the short-stalked, long-styled flowers always a certain proportion, varying from 5 to 20 per cent., contain *Blastophaga* larvae, yet there are no observable differences in this type of flowers at the time of pollination.

The single stamen is plainly divided into filament and anther in *Ficus populnea* (plate 8, fig. 10), and is larger than that of *F. aurea* in which the anther cells lie upon the top of a somewhat obliquely truncate column (plate 8, figs. 4-6). The calyx lobes in both staminate and pistillate flowers are smaller proportionally and more distinct in *F. aurea*. They are mostly three in number in both kinds of flowers. In *F. populnea*, at least in the specimens studied, the calyx lobes seem to be two in number in the pistillate flowers, and come well up above the top of the ovary. Possibly the larger lobe represents in reality a union of two. In the staminate flowers but one large lobe could be found. Whether it represents a union of several lobes or not was not determined. In both species the ripe achenes have an outer layer of cells that form mucilage in water. On drying, this serves to glue the achenes in place.

A study of the germination of the seeds of *Ficus aurea* revealed the very interesting fact that it is dependent upon light, not taking place if the achenes are left dark. The following experiments were performed in this connection:

October 22, 1907, several ripe fruits were opened and the achenes and surrounding pulp together with empty galls were placed in two Petri dishes upon filter paper moistened with Knop's mineral nutrient solution. One dish was placed on a table next to a north window, the other in the back of a long drawer in the same table. In the former the first signs of germination were observed November 1 and by November 6 apparently all the seeds had germinated. In the dark there

was no germination at this date. The dish was then placed in the light and in two days one seed, and in a week all the seeds, had germinated.

November 5 the achenes were carefully washed out of the pulp of some more fruits and thirty-three placed as above on filter paper in each of two dishes, one dish being placed in the dark as before. November 12 twelve of the seeds in the light showed germination while all thirty-three had germinated by the 16th (plate 9). On the 21st none of the seeds in the dark showing any signs of germination ten were transferred to the light to test whether they were still alive. In twenty-four hours one germinated, three days later five others split their seed coats, while eight days after the transfer to the light all had germinated. Five more seeds transferred to the light December 7 had begun to germinate by the 13th. Five more were transferred to the light December 21. On returning January 2 after a few days' absence they were all found to have germinated. January 7 none of the thirteen seeds still remaining in the dark had germinated. The whole dish was accordingly transferred to the light. The seeds, unfortunately, were allowed to dry out about January 1 and again January 12. On January 17th three seeds showed germination while in two or three others the seed-coats were beginning to split, showing that while the vitality had been apparently somewhat reduced the seeds were still capable of responding to the stimulus afforded by the light. By January 20 all the remaining seeds had germinated.

In a third experiment the achenes were washed free from empty galls and pulp and poured in water upon the surface of the soil in three pots, two being kept in a dark cupboard and one on a porch exposed to the sun in the early morning. In the latter, the seeds germinated in nine days while in the dark there was no germination in one pot after more than sixty days. After twenty-seven days the other pot was placed on the porch and germination was first noticed in thirteen days. In watering, the achenes had been partly covered with a thin layer of soil which perhaps explains why the germination was delayed until thirteen days had elapsed.

Similar experiments in Petri dishes with achenes of *Ficus populnea* showed a less marked light requirement for germination. On November 21 the seeds were sown, fifteen in each dish. On November 27 seven showed the beginning of germination in the dish in the light while by December 3 all fifteen had germinated. Not until December 6 did the first seed germinate in the dark, followed by one each on the 9th, 13th and 14th, three on the 16th, one on the 21st and one more by the 26th. The remaining six seeds not having germinated by January 7, the whole dish was placed in the light. Ten days later one seed had germinated while four more germinated by the 25th, the last seed germinating about February 1. It is probable that in this experiment the drawer in which the seeds were kept dark was not absolutely dark, as the cotyledons of the plantlets produced showed a very faint greenish tinge. The plants were extremely elongated, however, showing a great light deficiency. The conditions, however, were similar to those under which *F. aurea* refused to germinate.

The light requirement for germination on the part of *Ficus aurea* evidently stands in the closest relation to its mode of life and explains why the epiphytic habit is the only one assumed in the dense hammocks. As was mentioned before, the trees of *F. aurea* occurring in dense woods pass their early life as epiphytes. It is only in natural or artificial clearings, along rocky bluffs (plate 3) or canal banks, etc., where the shade is not too dense, that one finds young *F. aurea* not epiphytic. In the uncut hammocks the light even at midday resembles twilight in the open. On the ground under the shrubs and herbaceous undergrowth and covered by the constantly falling leaves it is evident that the seeds of *Ficus aurea* would be unable to germinate although they might obtain enough light for this purpose in a clearing or on a rocky bluff. So it is that in the hammocks only those seeds germinate that have been deposited in the tops of trees where they can obtain sufficient light. As is naturally to be expected, even in clearings and open places *Ficus aurea* will be found as an epiphyte as well as growing independently. In the case of *F. populnea* this lack of light doubtless has

some effect, but from the results of the experiment it is evident that but little light if any is necessary to cause some at least of the seeds to germinate. This, in the writer's opinion, is the explanation of the presence of this tree as a hammock inhabitant, without assuming the epiphyte habit.

There are but few plants known the seeds of which possess the peculiarity described above for *Ficus aurea*. Pfeffer* refers to Wiesner's† observation that the seeds of *Viscum album*, likewise epiphytic in habit, require light for their germination although this does not hold true for tropical species of *Viscum* nor for *Loranthus europaeus*. For the tropical *Viscum* species germination is favored by light although it is not necessary. In a footnote Pfeffer notes that Raciborski claims that light is requisite for the germination of *Nicotiana*. It is of interest that, while in *Viscum album* light is essential for germination of a seed, the seedling thus produced turns away from the light. This is not the case with either *Ficus aurea* or *F. populnea*, for their seedlings are very positively heliotropic. The roots, on the other hand, are rather distinctly negatively heliotropic. Both features are shown fairly well in plate 9 for *F. aurea*. In this respect these species are not confirmatory of Davenport's‡ conclusion that the inability of *Viscum album* to grow or germinate in the dark is correlated with the peculiarity in its phototropic response that the hypocotyl turns away from the light.

Subtropical Laboratory and Garden,
Miami, Florida.

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* Pfeffer, W. Pflanzenphysiologie. II Auflage. **2**: 105. (1904).

† Wiesner, J. Ueber die Ruheperiode und über einige Keimungsbedingungen der Samen von *Viscum album*. (Ber. Deutsch. Bot. Gesell. **15**[10]: 503–516. 1898).

‡ Davenport. Experimental Morphology. Part II. 423 and 438.

EXPLANATION OF PLATES.

All the photographs were made by the author except plates 6, 7 and 9 which were made by Mr. G. L. Fawcett. They were all taken in the vicinity of Miami, Florida, in the autumn and winter of 1907.

Plate 1.—*Ficus aurea* on *Quercus virginiana.*

Plate 2.—Young plant of *Ficus aurea* on *Sabal palmetto.*

Plate 3.—*Ficus aurea* growing non-epiphytically on a rocky ledge.

Plate 4.—1, Young seedling of *Ficus aurea* growing in a hole in the trunk of *Metopium metopium.* 2, *Ficus aurea* growing epiphytically on a dead trunk of *F. aurea.*

Plate 5.—1, *Ficus aurea* upon trunk of *Gymnanthes lucida* which it has killed. 2, *Ficus aurea* about twenty-five years old, planted as a yard tree.

Plate 6.—Fruiting branch of *Ficus aurea,* one-fourth natural size.

Plate 7.—Fruiting branches of *Ficus populnea,* three-eighths natural size.

Plate 8.—1-3, Pistillate flowers of *Ficus aurea* from a receptacle into which a *Blastophaga* had just entered, all magnified about 100 times. 4-5, Staminate flowers of *Ficus aurea* magnified about 35 times. 6, Top view of stamen of *Ficus aurea,* magnified about forty times. 7, *Blastophaga* gall of *Ficus aurea* from which the insect has just escaped, magnified about 25 times. 8-9, Pistillate flowers of *Ficus populnea* ready for pollination, magnified about 24 times. 10, Staminate flower of *Ficus populnea,* magnified about 24 times. All drawn with the aid of camera lucida.

Plate 9.—Germination of *Ficus aurea* in light and in dark. The Petri dish showing the little seedlings was exposed to the light. The positive heliotropism of the hypocotyls and the quite marked negative heliotropism of the roots is shown.

FICUS AUREA on QUERCUS VIRGINIANA.

FICUS AUREA ON SABAL PALMETTO.

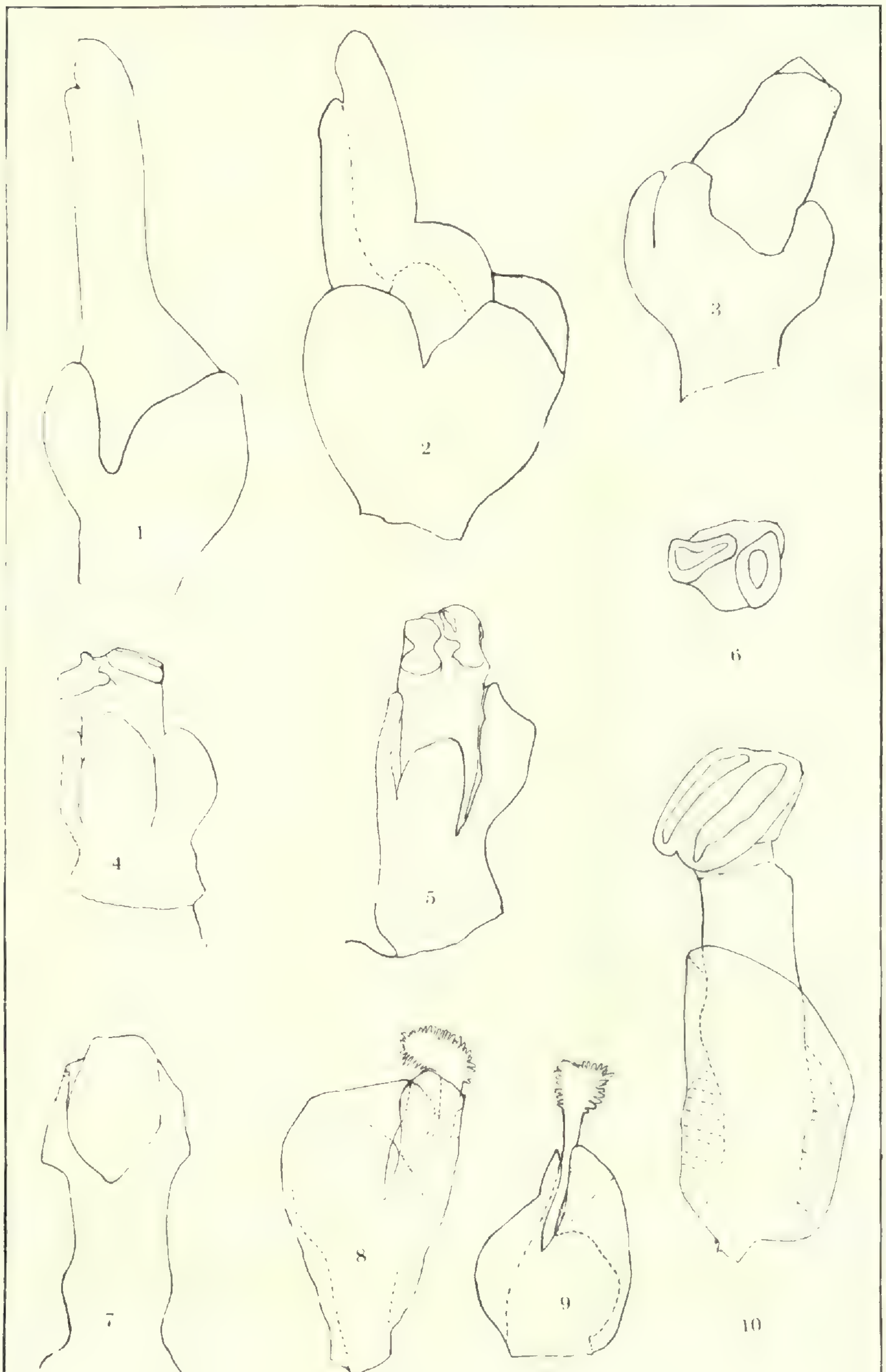
FICUS AUREA

FICUS AUREA.

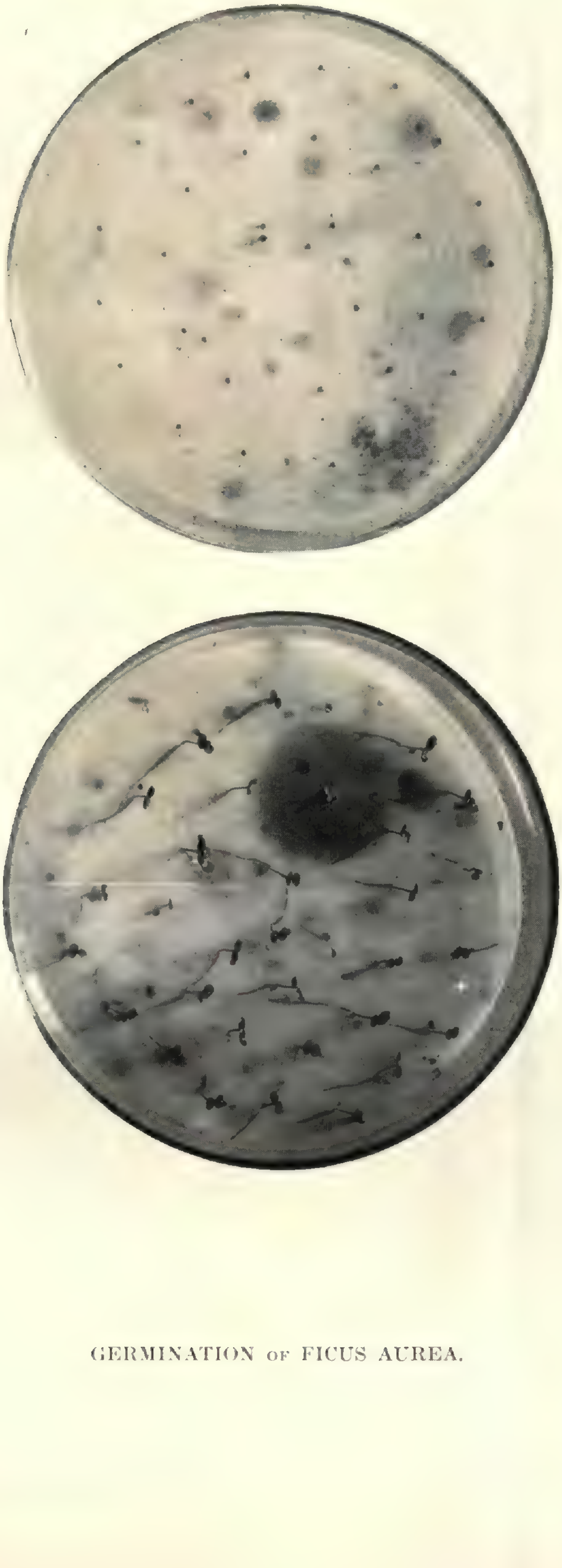
FICUS AUREA.

FICUS AUREA.

FICUS POPULNEA.



FICUS AUREA and F. POPULNEA.



GERMINATION of FICUS AUREA.

CRATAEGUS IN MISSOURI.

BY CHARLES SPRAGUE SARGENT.

In this paper an attempt is made to record the information in regard to the Missouri species of Crataegus which has been brought together in the last eight years. In it are also included descriptions of several of the species which occur on the bottoms of the Mississippi River in Illinois opposite St. Louis as these seem naturally to belong to the St. Louis flora. This, however, must be considered merely a preliminary study of the subject, for Crataegus has been systematically observed and collected at a few places only in Missouri, and there are still many counties, including all that part of the state north of the Missouri River, in which there is every reason to believe that the genus abounds and in which no collections have been made. The existence, too, of several undescribed Missouri species is indicated by incomplete material preserved in the herbaria of the Arnold Arboretum and of the Missouri Botanical Garden, which cannot yet be satisfactorily determined.

Exclusive of the seven Illinois species, there are described in this paper one hundred and three species, and of these only five are now known to extend beyond the borders of the state, although no doubt some of the southern species will be found in northern Arkansas where Crataegus has been very little investigated.

An examination of the groups into which the Missouri species fall naturally throws some light on the distribution of these groups and shows what a barrier the wide bottomlands of the Mississippi have been in the spread westward of several of them.

The Crus-galli Group, with thirty-seven endemic species, is the largest of the Missouri groups. Plants of this group are very abundant in the southern part of the state, in Arkansas, western Louisiana and eastern Texas, where they sometimes grow to a large size. Rare in the northeastern part

of the country, and nowhere very abundant in the region east of the Mississippi River, this is the characteristic group of the region west of the Mississippi River from southern Missouri to the Gulf.

Although *Crataegus punctata* Jacquin, the type of the Punctatae Group, one of the most widely distributed of the northeastern species, and common in central and northern Illinois, does not cross the Mississippi River, this group is well represented in the southern part of the state. In addition to the eleven species described in this paper, there are evidences that several other Punctatae are to be found in the southeastern counties, including perhaps *Crataegus collina* Chapman, of the southern Appalachian region.

Of the Virides Group, the best represented of the natural groups with the exception of the Crus-galli in southern Arkansas, western Louisiana and eastern Texas, *Crataegus viridis* Linnaeus is one of the four species of wide distribution which reaches Missouri. Five other species of this group described in this paper are found only on the Mississippi bottoms in Illinois, and four have not been seen beyond the boundaries of the state.

The Pruinosae, which is one of the large and most generally distributed of the northeastern groups, is represented in Missouri by sixteen species, and appears to be pretty generally distributed over the state, at least in that part of it south of the Missouri River.

Of the Tenuifoliae, which is the largest of all the groups in the northeastern part of the country, no representative has been found in Missouri, although many Tenuifoliae occur in northern Illinois. The Flabellatae, too, which abound in the region extending from New England through New York, Ontario and southern Michigan to northern Illinois, where they often grow to a large size, appear to be entirely absent from Missouri and probably do not cross the Mississippi River.

In the Molles Group, which is very generally distributed from the St. Lawrence River valley and eastern New England to eastern Nebraska and Kansas, eleven species are here described. In the eastern states many of the species in

this group have only ten stamens; west of the Mississippi River only species with twenty stamens have been found. Of the Missouri species of this group only *Crataegus mollis* Scheele extends beyond the limits of the state, and one other of the species now described is found only on the Mississippi bottoms in Illinois. Species in this group abound in the neighborhood of St. Louis and in Jackson and Jasper Counties. One species still undescribed occurs in Taney County, and although one species is known in Shannon County and another in St. François County, the Molles Group cannot be considered very abundant in the southeastern part of the state.

It is interesting to find in parts of the state remote from one another two species of the small group of Dilatatae which is otherwise distinctly northeastern, with species extending from Quebec and eastern Massachusetts to New York and southern Ontario.

The Coccineae Group, which is most abundant in species on the New England seacoast and the valley of the St. Lawrence River and to which belong the most northern species of the genus in America, is represented in Missouri by a single rather abnormal species, *Crataegus Margaretta* Ashe, first discovered in the neighborhood of St. Louis but now known to range to middle Tennessee, Iowa and southern Ontario.

The Uniflorae, a group of a few small shrubs otherwise found in the Atlantic-coast region from New Jersey southward and on the foothills of the southern Appalachian Mountains, appears in southern Missouri with a single distinct species; while four Missouri species represent the Intricatae, a large eastern and southern Appalachian group most abundant in species in eastern Pennsylvania and extending to southern Michigan and to Mississippi, but west of the Mississippi River found only in Shannon and Taney Counties, Missouri. Of the three species of the Microcarpae Group only one, *Crataegus cordata* Aiton, reaches southern Missouri from the Atlantic states, although in Jasper County there are indications that an undescribed species of this group occurs.

The great Tomentosae Group, with only thirteen species, is certainly not as well represented in Missouri as it is in many parts of the country east of the Mississippi River, especially in Ontario, where the species of this group form a considerable part of the Crataegus vegetation. It seems remarkable that only three species of the thick-leaved section of this group have been found in Missouri, although species of thick-leaved Tomentosae are common in northern Illinois. The type of this group, *Crataegus tomentosa* Linnaeus, is one of the four species of wide distribution which have been found in Missouri.

No representative of the great Flavae Group, which is the prevailing and most generally distributed group in the southeastern states, has been found in Missouri where there are no indications of the existence of the small but interesting eastern Anomalae Group or of the Bracteatae, Pulcherrimae, Triflorae, Aestivales or Brachycarpae, small southern groups.

Although I have made a number of visits to Missouri in the last eight years to study Crataegus and to introduce the most interesting of these plants into the Arnold Arboretum, the real work of collecting and field observation in the genus has been chiefly done in Missouri by Mr. B. F. Bush of Courtney, Jackson County, who has made many journeys in the southern counties to collect Crataegus, by Mr. E. J. Palmer of Webb City, Jasper County, which is one of the richest known Crataegus regions in the state, and by Mr. J. H. Kellogg of the Missouri Botanical Garden, who has worked assiduously during several years to increase the knowledge of these plants in the neighborhood of St. Louis. Unaided by their zeal, patience and industry, it would have been impossible for me to have prepared this preliminary report.

An earlier student of Crataegus in Missouri is Mr. G. W. Letterman of Allenton, St. Louis County, who began to study the genus before 1880. In that year he sent seeds of Crataegus to the Arboretum; and from these seeds were raised the plants which have since been described as *Crataegus nitida*, *Crataegus fecunda*, *Crataegus coccinioides*, *Crataegus Dawsoniana* and *Crataegus succincta;* and it was the

flowering and fruiting of these plants in the Arboretum that first showed me the variety and importance of the Missouri Crataegus flora and led me to undertake its investigation.

It is a great satisfaction to me that the results of this investigation appear among the publications of the Missouri Botanical Garden; for Professor Trelease has often been my companion in journeys made for the purpose of studying Crataegus in the field; and the resources of the Garden for many years have been freely devoted to aiding these studies.

SYNOPSIS OF GROUPS.

A. Nutlets without ventral cavities. (Groups CRUS-GALLI to MICROCARPAE.)
   a. Veins of the leaves extending to the points of the lobes only. (Groups CRUS-GALLI to UNIFLORAE.)
   b. Veins of the leaves extending to the points of the lobes and to the sinuses. (Group MICROCARPAE.)

B. Nutlets with longitudinal cavities on their ventral faces. (Group TOMENTOSAE.)

CRUS-GALLI.

Leaves subcoriaceous to coriaceous or less commonly thin, obovate to oval, ovate or rhombic, cuneate at the base, usually serrate only above the middle, without lobes except on vigorous shoots, their veins usually thin and often within the parenchyma; petioles short, usually eglandular; fruit subglobose to short-oblong, oval or ovate, 7–25 mm. in diameter, with thin usually greenish flesh; nutlets 1–3, rarely 4 or 5.

Leaves subcoriaceous to coriaceous.
Corymbs, leaves and branchlets glabrous or slightly hairy while young.
Stamens 8–10 (occasionally 15 in No. 2, 5–10 in No. 6, and 5–8 in No. 13).
Anthers rose color or pink.
Leaves oblong-obovate, rounded or occasionally acute at the apex.
Flowers in 15–20-flowered corymbs; anthers pink; fruit short-oblong to ovate, dull red.
1. *C. strongylophylla.*
Flowers in 10–18-flowered corymbs; anthers 10–15; styles 3–5; fruit short-oblong to subglobose, dull red blotched with green.
2. *C. discolor.*

Leaves oblong-obovate, acute and short-pointed at the apex; anthers pink; fruit short-oblong to ovate.

Flowers in mostly 10–14-flowered corymbs; calyx-lobes villose on the inner surface; styles 2; fruit dull yellow, with an orange-red cheek; spines slender, usually straight. 3. *C. infesta.*

Flowers in mostly 7–10-flowered corymbs; calyx-lobes glabrous; style generally 1; fruit bright orange-red blotched with green; spines stout, usually strongly hooked. 4. *C. hamata.*

Leaves oblong-obovate, acuminate, with prominent mid-ribs and veins; flowers in many-flowered corymbs; anthers pale salmon color; fruit subglobose, dark red flushed with green. 5. *C. severa.*

Leaves obovate, usually acuminate or rounded at the apex; flowers in 15–20-flowered corymbs; stamens 5–10; anthers pale salmon color; fruit short-oblong, dull red blotched with green. 6. *C. tardiflora.*

Leaves oblong-obovate to oval.

Leaves coarsely serrate; flowers in many-flowered corymbs; pedicels slightly hairy while young; anthers dark rose color; fruit short-oblong to subglobose, orange-red. 7. *C. fecunda.*

Leaves finely serrate; flowers in 4–7-flowered corymbs; pedicels glabrous; anthers pink; fruit oval to ovate, dull green, with a reddish cheek. 8. *C. tenuis.*

Leaves oval to rhombic; flowers in mostly 10–12-flowered corymbs; anthers rose color; fruit subglobose to short-oblong, dull red. 9. *C. tantula.*

Anthers yellow.

Leaves oblong-obovate, rounded or acute at the apex.

Flowers in 15–25-flowered corymbs; fruit subglobose to obovate. 10. *C. barrettiana.*

Flowers in mostly 7–12-flowered corymbs.

Primary veins mostly within the parenchyma.

Calyx-lobes villose on the inner surface; fruit broader than high, truncate at the ends, slightly angled, dark crimson; spines stout. 11. *C. efferta.*

Calyx-lobes glabrous; fruit subglobose to short-oblong or slightly obovate, scarlet; spines slender. 12. *C. ferox.*

Primary veins prominent.

Leaves rounded or rarely acute at the apex; fruit short-oblong to slightly obovate, rounded at the ends, dull crimson, 7–8 mm. in diameter. 13. *C. albanthera.*

Leaves acute, rounded and short-pointed or acuminate at the apex; fruit short-oblong, truncate at the ends, scarlet, up to 1.5 cm. long. 14. *C. pachyphylla.*

Leaves oblong-obovate, acuminate, or rarely rounded at the apex; flowers in mostly 12–16-flowered corymbs; stamens 5–8, usually 5 or 6; fruit short-oblong, dark red. 15. *C. candens.*

Leaves narrowly obovate, acute or acuminate or rarely rounded at the apex, their veins mostly within the parenchyma; flowers in usually 10–12-flowered corymbs; styles generally 1; fruit oval to ovate, dull red. 16. *C. monosperma.*

Leaves oblong-obovate, rounded or truncate at the broad apex, their veins mostly within the parenchyma; flowers in compact 5–15-flowered corymbs; fruit short-oblong to slightly obovate, crimson. 17. *C. truncata.*

Leaves oval to slightly obovate, acute or acuminate at the apex, their veins within the parenchyma; flowers in 10–15-flowered corymbs; fruit subglobose to short-oblong, crimson; spines small and slender, often wanting. 18. *C. tenuispina.*

Leaves broadly obovate to oblong, rounded or acute at the apex, their veins within the parenchyma; flowers in many-flowered corymbs; fruit subglobose, dull green tinged with red. 19. *C. Palmeri.*

Stamens 20.

Anthers rose color or pink.

Flowers in 7–10-flowered corymbs; anthers pink; styles 2–4, usually 3; fruit often broader than high, bright cherry-red; leaves on vigorous shoots broadly ovate to orbicular. 20. *C. rotunda.*

Flowers in 5- or 6-flowered corymbs; anthers rose color; styles often 5; fruit short-oblong, pale cherry-red; leaves on vigorous shoots ovate to oval. 21. *C. parciflora.*

Anthers yellow; leaves broadly ovate to obovate, their veins mostly within the parenchyma; flowers in wide many-flowered corymbs; fruit subglobose, crimson. 22. *C. jasperensis.*

Corymbs, leaves and young branches more or less villose or pubescent during the season.

Stamens 10.

Anthers rose or pale salmon color.

Pedicels only slightly hairy; calyx-tube glabrous.

Mature leaves smooth on the upper surface; anthers rose color; fruit orange-red, with a yellow cheek. 23. *C. Engelmanni.*

Mature leaves scabrate on the upper surface; anthers pale salmon color; fruit green tinged with red. 24. *C. hirtella.*

Pedicels densely villose; calyx-tube hairy; anthers pale salmon color; fruit dark red. 25. *C. barbata.*

Anthers pale yellow.

Leaves smooth on the upper surface; corymbs broad, many-flowered, slightly villose; calyx glabrous. 26. *C. pilifera.*

Leaves scabrate on the upper surface; corymbs compact, few-flowered, densely villose; calyx villose. 27. *C. villiflora.*

Leaves comparatively thin.

Corymbs, leaves and branchlets glabrous or slightly hairy while young.

Anthers rose color (pink in No. 29).

Stamens 10.

Flowers in 8–12-flowered corymbs.

Leaves oblong-obovate, hairy only on the upper side of the midribs in early spring; fruit short-oblong, green tinged with red, 1–1.2 cm. in length. 28. *C. permera.*

Leaves short-obovate, bright red and covered above by short white hairs in early spring; anthers pale pink; fruit subglobose, bright orange-red, 8–9 mm. in diameter. 29. *C. rubrifolia.*

Flowers in 5- or 6-flowered corymbs; fruit oval, orange-red. 30. *C. consueta.*

Stamens 15; flowers in 5- or 6-flowered corymbs; fruit short-oblong, orange-red. 31. *C. tenuisepala.*

Stamens 20; flowers in 10–15-flowered corymbs; fruit short-oblong to obovate, bright orange-red. 32. *C. leptophylla.*

Anthers yellow.

Stamens 10.

Leaves lustrous above.

Flowers in many-flowered corymbs.

Leaves oval to oblong-obovate, acute or acuminate at the apex; fruit short-oblong, bright scarlet. 33. *C. acutifolia.*

Leaves rhombic to oval or slightly ovate; fruit subglobose to short-oblong, orange-red. 34. *C. rubrisepala.*

Flowers in mostly 7–12-flowered corymbs; leaves obovate, rounded or acute at the apex; fruit oval to subglobose, scarlet. 35. *C. rudis.*

Leaves dull green, ovate to obovate; flowers in many-flowered corymbs; fruit subglobose, flattened at the ends, dark dull crimson. 36. *C. erecta.*

Stamens 20; leaves oval to obovate or suborbicular, rounded or acute at the apex, coarsely serrate; flowers in 8–10-flowered corymbs, slightly villose while young; fruit subglobose, dark dull crimson. 37. *C. insignis.*

Corymbs, leaves and young branches more or less villose or pubescent during the season.

Stamens 10; anthers rose color; corymbs compact, mostly 6–8-flowered.

Leaves oblong-obovate, usually acuminate; corymbs sparingly villose; fruit crimson, lustrous, on glabrous pedicels. 38. *C. setosa.*

Leaves oblong-obovate to oval, rounded or acute at the apex; corymbs densely villose; fruit scarlet, pruinose, on hairy pedicels. 39. *C. munita.*

Stamens 10–15; anthers pink; corymbs slightly villose, broad, usually 15–20-flowered; leaves oblong-obovate, rounded or acute at the apex; fruit dull crimson blotched with green. 40. *C. vallicola.*

1. **Crataegus strongylophylla,** n. sp.

Glabrous. Leaves oblong-obovate, rounded at the broad apex or very rarely acute, gradually narrowed to the concave-cuneate entire base, and sharply often doubly serrate above, with straight or incurved glandular teeth; more than half-grown when the flowers open from the 10th to the middle of May and then thin, yellow-green and lustrous above and paler below, and at maturity subcoriaceous to coriaceous, dark yellow-green and very lustrous on the upper surface, dull light yellow-green on the lower surface, 4–5.5 cm. long and 2.5–3 cm. wide, with prominent yellow midribs, and thin usually prominent primary veins; petioles stout, narrow-wing-margined nearly to the base, glandular towards the apex, with often persistent glands, 7–10 mm. in length. Flowers about 1 cm. in diameter, on long slender pedicels, in lax mostly 15–20-flowered corymbs, the much elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from wide bases, acuminate and red at the apex, entire or furnished near the middle with occasional glandular teeth, reflexed after anthesis; stamens 10; anthers pink; styles 1–3. Fruit ripening in October, on slender reddish pedicels, in 6–12-fruited drooping clusters, short-oblong to ovate, full and rounded at the ends, dull red, marked by large dark dots, 8–10 mm. long and 6–9 mm. in diameter; calyx little enlarged, with a deep narrow cavity, and spreading and incurved persistent lobes; flesh thin, greenish yellow, dry and mealy; nutlets 1–3, gradually narrowed and rounded at the ends, prominently ridged on the back, with a broad high grooved ridge, 7–8 mm. long, and 4–4.5 mm. wide, or when 1, 6–6.5 mm. in diameter.

A tree 2–4 m. high, with a small stem, large horizontal wide-spreading branches, and stout nearly straight branchlets dark orange-green and marked by pale lenticels when they first appear, orange-green or chestnut-brown and lustrous in their first season and dull reddish brown the following year, and armed with numerous stout straight or slightly curved purple shining spines 3.5–5 cm. long.

Dry rocky hills. Jasper County, common; near Webb City, *E. J. Palmer* (No. 31 type) May 9 and October 4, 1907; Neck City, *E. J. Palmer*, April 28, 1907.

2. **Crataegus discolor,** n. sp.

Glabrous with the exception of the hairs on the upper side of the young leaves and petioles and on the calyx-lobes. Leaves obovate-cuneate, rounded or acute at the apex, and finely serrate above the middle, with incurved glandular teeth; when they unfold deeply tinged with red and covered on the upper surface with soft white hairs, nearly half-grown when the flowers open during the first week in May and then thin, yellow-green, lustrous and slightly hairy along the midribs above, and glaucous below,

and at maturity thin but firm in texture, light yellow-green and lustrous on the upper surface, pale on the lower surface, 3–4 cm. long and 2–2.5 cm. wide, with slender yellow midribs, and thin primary veins mostly within the parenchyma; petioles slender, narrow-wing-margined nearly to the base, soon glabrous, 4–6 mm. in length; leaves on vigorous shoots broadly obovate, usually rounded and short-pointed at the apex, or rhombic to oval and acuminate, more coarsely serrate, and often 5–5.5 cm. long and 4–4.5 cm. wide, with foliaceous lunate coarsely serrate stipules. Flowers 1.5–1.7 cm. in diameter, on long slender pedicels, in wide mostly 10–18-flowered corymbs, the long slender lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes wide, acuminate and rose-colored at the apex, minutely glandular-serrate, sparingly villose on the inner surface, reflexed after anthesis; stamens 10–15, usually 10; anthers pale rose color; styles 3–5, surrounded at the base by a ring of pale hairs. Fruit ripening the middle of October, on slender drooping pedicels, in few-fruited clusters, short-oblong to subglobose, full and rounded at the ends, dull red more or less blotched with green, 8–10 mm. in diameter; calyx little enlarged, with a narrow shallow cavity, and small closely appressed persistent lobes; flesh thin, yellow-green, dry and mealy; nutlets 3–5, gradually narrowed and rounded at the ends, or when 5 acute at the ends, ridged on the back, with a high broad deeply grooved ridge, 6.5–7 mm. long, and about 4 mm. wide.

A tree 6–8 m. high, with a trunk 1.5–3 dm. in diameter, horizontal branches forming a broad flat-topped head, and stout slightly zigzag branchlets light orange-green and marked by pale lenticels when they first appear, becoming dark red-brown in their first season and dull gray the following year, and armed with numerous stout straight spines 4–5 cm. long.

Near Grandin, Carter County, *B. F. Bush* (No. 3 type), May 6 and Oct. 10, 1905, (No. 3 A) Oct. 11, 1905, also (Nos. 365, 393, 411, 412 and 413) May 1901.

3. **Crataegus infesta,** n. sp.

Glabrous with the exception of the hairs on the upper surface of the young leaves and on the calyx-lobes. Leaves erect, oblong-obovate, acute and short-pointed or rounded at the apex, and coarsely serrate above the middle, with incurved glandular teeth; slightly hairy on the upper surface when they unfold, very thin, light yellow-green, lustrous and glabrous above, with the exception of a few hairs on the midribs, and pale below when the flowers open in the first week of May, and at maturity coriaceous, light yellow-green and very lustrous on the upper surface, paler on the lower surface, 3–3.5 cm. long and 1.5–1.8 cm. wide, with thin midribs rose-colored toward the base, and slender mostly prominent primary veins; petioles stout, narrow-wing-margined nearly to the base,

deep rose color in the autumn, 3–4 mm. in length. Flowers 1.2–1.4 cm. in diameter, on long slender pedicels, in crowded mostly 10–14-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from the base, long, slender, acuminate, irregularly glandular-dentate, glabrous on the outer, sparingly villose on the inner surface, reflexed after anthesis; stamens 8–10; anthers pink; styles 2. Fruit ripening at the end of September, on stout erect or spreading pedicels, in 2- or 3-fruited clusters, short-oblong to ovate, dull yellow, with an orange-red cheek, 1–1.1 cm. long and 9–10 mm. in diameter; calyx prominent, with a short tube, a wide deep cavity broad in the bottom, and spreading persistent lobes; flesh thin, green, dry and hard; nutlets usually 2, rounded and obtuse at the ends, ridged on the back, with a broad low ridge, 6.5–7 mm. long, and 3–3.5 mm. wide.

A tree 3–5 m. high, with a trunk often 1 dm. in diameter, covered with dark scaly bark, large spreading and erect branches forming a round-topped head, and stout branchlets green tinged with red and marked by pale lenticels when they first appear, becoming light chestnut-brown and very lustrous in their first season and dull red-brown the following year, and armed with very numerous slender straight or slightly curved dark purple shining spines 4.5–5 cm. long and persistent on old stems and branches; or often shrubby in habit.

Dry limestone hills, Pacific, Franklin County, *J. H. Kellogg* (No. 2 type), May 8, 1905, *J. H. Kellogg* and *C. S. Sargent*, September 29, 1907.

4. **Crataegus hamata,** n. sp.

Glabrous with the exception of the hairs on the upper surface of the young leaves and petioles. Leaves erect at the ends of the branches, oblong-obovate, and short-pointed or rounded at the apex, gradually narrowed to the entire base, and finely serrate above the middle, with incurved glandular teeth; about one-third grown when the flowers open in the first week of May and then thin, yellow-green, smooth, lustrous and slightly hairy along the midribs above and pale below, and at maturity subcoriaceous, smooth, lustrous, light yellow-green and glabrous on the upper surface, pale on the lower surface, 5.5–6 cm. long and 3–5 cm. wide, with thick midribs, and slender prominent primary veins; petioles stout, narrow-wing-margined, slightly hairy on the upper side while young, soon becoming glabrous, occasionally glandular, 7–8 mm. in length; leaves on vigorous shoots obovate, acuminate and abruptly short-pointed at the apex, acuminate at the base, more coarsely serrate, slightly lobed above the middle, 6–7 cm. long and 4.5–5 cm. wide, with rose-colored midribs, more prominent veins and stout broadly winged rose-colored petioles. Flowers

about 1.2 cm. in diameter, on long slender pedicels, in small mostly 7–10-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from the base, short, wide, acuminate, irregularly glandular-serrate, reflexed after anthesis; stamens 8–10; anthers pink; styles 1 or 2, usually 1. Fruit ripening the middle of October, on very slender red pedicels, in few-fruited drooping clusters, short-oblong to ovate, light orange-red more or less blotched with pale green, lustrous, marked by large dark dots, 1.2–1.3 cm. long and 1.1–1.2 cm. in diameter; calyx little enlarged, with a deep narrow cavity, and small spreading often deciduous lobes; flesh thick, yellow-green, rather juicy; nutlets 1 or 2, usually 1, gradually narrowed to the rounded ends, slightly ridged on the back, with a narrow grooved ridge, 7–8 mm. long, and 4–4.5 mm. in diameter.

A tree 3–4 m. high, with a stout stem 7.5–10 cm. in diameter, covered with dark scaly bark, small erect and slightly spreading branches forming a wide irregular head, slender zigzag branchlets dark orange-green when they first appear, becoming light dull chestnut-brown and marked by small pale lenticels in their first season and light gray-brown the following year, and armed with stout hooked or occasionally nearly straight purplish shining ultimately dull gray spines 3.5-4 cm. long.

Pacific, Franklin County, *J. H. Kellogg* (No. 6 type), October 19, 1901, May 8, 1905, *J. H. Kellogg* and *C. S. Sargent*, Sept. 27, 1907, (No. 4) *J. H. Kellogg*, May and October 1905.

5. CRATAEGUS SEVERA Sargent, Trees and Shrubs, ii. 59, t. 127 (1908).

Banks of streams, Grandin, Carter County, *C. S. Sargent* (No. 5) October 1900, *B. F. Bush* (No. 410), May 1901.

6. Crataegus tardiflora, n. sp.

Glabrous with the exception of the hairs on the inner surface of the calyx-lobes. Leaves obovate, rounded or usually acuminate at the apex, gradually narrowed to the concave-cuneate entire base, and finely serrate above the middle, with incurved glandular teeth; deeply tinged with red when they unfold, nearly fully grown when the flowers open from the 20th to the end of May and then yellow-green, smooth and lustrous above and pale below, and at maturity subcoriaceous, dark yellow-green, smooth and lustrous on the upper surface, dull bluish green on the lower surface, 4–5 cm. long and 2.5–3 cm. wide, with stout prominent yellow midribs, and thin prominent primary veins; petioles stout, wing-margined to the base, 5–7 mm. in length; leaves on vigorous shoots acuminate at the ends, coarsely

serrate, often 5–8 cm. long and 3.5–4 cm. wide, with stouter midribs and petioles, more prominent primary veins, and foliaceous lunate serrate stipules. Flowers 1.2–1.3 cm. in diameter, on long slender pedicels, in wide lax mostly 15–20-flowered corymbs, the elongated lower peduncles from the axils of the upper leaves; calyx-tube narrowly obconic, the lobes long, slender, acuminate, entire or minutely dentate near the middle, sparingly villose on the inner surface, reflexed after anthesis; stamens 5–10; anthers pale salmon color; styles 1 or 2, or rarely 3. Fruit ripening early in October, on long slender drooping pedicels, in few-fruited clusters, short-oblong, full and rounded at the ends, dull red blotched with green, 1–1.2 cm. in diameter; calyx little enlarged, with a deep narrow cavity, and slightly spreading or incurved often deciduous lobes; flesh thin, green, dry and hard; nutlets 1–3, rounded and obtuse at the ends, ridged on the back, with a high broad slightly grooved ridge, 7–7.5 mm. long, and about 3 mm. wide, or when 1, 5.5–6 mm. in diameter.

A tree often 4 or 5 m. high, with a trunk sometimes 1.5–2 dm. in diameter, small spreading branches forming a wide flat-topped head, and stout slightly zigzag branchlets dark orange-green faintly tinged with red when they first appear, becoming dull reddish brown in their first season and ashy gray the following year, and armed with numerous slender nearly straight chestnut-brown shining ultimately dark gray spines 2–4.5 cm. long.

Roadsides five miles north of Swan, in Christian County, *B. F. Bush* (No. 16 type), Sept. 28, 1905, April 20 and May 26, 1907.

This is the last of the Crus-galli species of this region to flower.

7. CRATAEGUS FECUNDA Sargent, Bot. Gazette, xxxiii. 111 (1902); Silva N. Am. xiii. 47, t. 641; Manual, 371, f. 289.

Near Allenton, St. Louis County, and Mississippi River bottoms, East St. Louis, Illinois.

8. **Crataegus tenuis,** n. sp.

Leaves oblong-obovate to oval, acute or acuminate and short-pointed or rounded at the apex, gradually narrowed and cuneate at the entire base, and finely crenately serrate above; about half-grown when the flowers open at the end of April or early in May and then thin, light yellow-green and hairy along the midribs above and pale and occasionally villose on the midribs below, and at maturity subcoriaceous, glabrous, dark green and lustrous on the upper surface, dull green on the lower surface, 2.5–3.5 cm. long and 1.5–1.8 cm. wide, with thin midribs, and obscure primary veins

mostly within the parenchyma; petioles stout, slightly wing-margined, often rose color in the autumn, 4–5 mm. in length; leaves on vigorous shoots oval to slightly obovate, rounded and short-pointed at the apex, abruptly concave-cuneate at the base, 3–4 cm. long and 2–2.5 cm. wide, with stouter rose-colored midribs, and more prominent primary veins. Flowers about 1 cm. in diameter, on long slender glabrous pedicels, in mostly 4–7-flowered simple corymbs; calyx-tube narrowly obconic, the lobes gradually narrowed from the base, broad, short, acuminate and glandular at the apex, entire or minutely and irregularly glandular-dentate, reflexed after anthesis; stamens 10; anthers pink; styles 2. Fruit ripening in October, on slender erect pedicels, in few usually 1- or 2-fruited clusters, oval to ovate, dull green, with a reddish cheek, marked by large pale dots, 9–10 mm. long and 6–7 mm. in diameter; calyx prominent, with a short tube, a deep narrow cavity, and large spreading and erect persistent lobes; flesh green, thin, dry and hard; nutlets 2, obtuse and rounded at the ends, slightly ridged on the back, 6–6.5 mm. long, and 4.5–5 mm. wide.

A tree sometimes 7 m. high, with a tall trunk 2–2.5 dm. in diameter, covered with very dark scaly bark, small spreading branches forming an oblong round-topped head, and very slender nearly straight glabrous branchlets light reddish brown and marked by pale lenticels when they first appear, becoming light chestnut-brown and lustrous in their first season and dull gray the following year, and armed with numerous slender nearly straight purple shining spines 3–4 cm. long.

Pacific, Franklin County, *J. H. Kellogg* (No. 7 type), May 2, 1905, *J. H. Kellogg* and *C. S. Sargent*, September 29, 1907.

9. **Crataegus tantula,** n. sp.

Glabrous with the exception of the hairs on the young leaves, calyx-lobes and branchlets. Leaves oval to rhombic or to ovate or occasionally obovate, acuminate, gradually narrowed to the concave-cuneate entire base, and finely serrate above, with straight or incurved glandular teeth; nearly half-grown when the flowers open about the 20th of May and then thin and yellow-green, villose above along the midribs, with long white deciduous hairs, and slightly hairy in the axils of the veins below, and at maturity subcoriaceous, dark green and very lustrous on the upper surface, pale yellow-green on the lower surface, 3–4 cm. long and 1.5–2 cm. wide, with slender yellow midribs, and obscure primary veins within the parenchyma; petioles slender, slightly wing-margined at the apex, sparingly villose while young, becoming glabrous, often rose color in the autumn, 5–7 mm. in length. Flowers 1.2–1.3 cm. in diameter, on long slender glabrous pedicels, in small mostly 10–12-flowered crowded corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, gla-

brous, the lobes slender, acuminate, entire or minutely dentate near the middle, glandular on the outer, slightly villose on the inner surface, reflexed after anthesis; stamens 10; anthers rose color; styles 2 or 3, usually 3. Fruit ripening the end of October, on long slender drooping pedicels, in few-fruited clusters, subglobose to short-oblong, dark red, marked by large dark dots, 7–8 mm. in diameter; calyx prominent, with a deep shallow cavity, and spreading or incurved persistent lobes; flesh thin, hard, yellow-green, dry and mealy; nutlets usually 3, gradually narrowed and rounded at the ends, ridged on the back, with a low grooved ridge, 5–5.5 mm. long, and 3–3.5 mm. wide.

A tree 5–8 m. high, with a trunk 2–3 dm. in diameter, covered with dark rough scaly bark, spreading branches forming a broad round-topped head, and small slender branchlets light orange color and covered with long pale hairs when they first appear, soon becoming glabrous, light chestnut-brown, lustrous and marked by small pale lenticels in their first season and orange or reddish brown the following year, and unarmed or furnished with short slender nearly straight dark purplish spines.

Thickets and the borders of woods, in low moist soil, near Webb City, Jasper County, *B. F. Bush* (No. 10 type), May 23, 1901, *E. J. Palmer* and *C. S. Sargent*, Oct. 2, 1901, *E. J. Palmer*, Oct. 20, 1901.

This handsome plant is well distinguished from related species by its small usually oval or rhombic leaves, by its small flowers and fruits and the infrequency of its spines.

10. **Crataegus barrettiana,** n. sp.

Glabrous with the exception of the hairs on the calyx-lobes. Leaves oblong-obovate, rounded or occasionally acute and short-pointed at the apex, gradually narrowed to the concave-cuneate entire base, and sharply serrate above the middle, with straight glandular teeth; nearly fully grown when the flowers open from the 10th to the middle of May and then thin, dark yellow-green and lustrous above and pale below, and at maturity thin, dark yellow-green, smooth and lustrous on the upper surface, pale yellow-green on the lower surface, 4–4.5 cm. long and 2–3 cm. wide, with thin midribs, and prominent primary veins; petioles slender, narrow-winged to below the middle, 6–7 mm. long; leaves on vigorous shoots usually rounded at the apex, more coarsely serrate, and often 5.5–6.5 cm. long and 4.5–5 cm. wide. Flowers about 1.2 cm. in diameter, on long very slender pedicels, in wide mostly 15–25-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes long, slender, acuminate and glandular at the apex,

entire or occasionally minutely dentate near the middle, glabrous on the outer, sparingly villose on the inner surface, reflexed after anthesis; stamens 10; anthers pale yellow; styles 2 or 3. Fruit ripening and falling late in September, on slender drooping pedicels, in few-fruited clusters, subglobose to slightly obovate, dull red or bronze color, marked by small pale dots, 1–1.2 cm. in diameter; calyx little enlarged, with a deep narrow cavity tomentose in the bottom, and small spreading lobes mostly deciduous from the ripe fruit; flesh thin, dry, green and hard; nutlets 2 or 3, gradually narrowed and rounded at the ends, irregularly ridged on the back, with a high broadly grooved ridge, 7–7.5 mm. long, and about 4 mm. wide.

A shrub 3 or 4 m. high, with stout stems covered with dark red-brown scaly bark, small ascending and spreading branches forming a narrow open head, and slender nearly straight branchlets dark orange-green more or less tinged with red and marked by pale lenticels when they first appear, becoming dark chestnut-brown and lustrous in their first season and dull red-brown the following year, and armed with stout or slender, straight or slightly curved, dark chestnut-brown shining spines 3–4 cm. long.

Rich bottom-lands in White Oak woods near Barrett's Station, St. Louis County, *J. H. Kellogg* (No. 2 type), May 9, 1903, May 13, 1907, *J. H. Kellogg* and *C. S. Sargent*, September 28, 1907.

11. **Crataegus efferta,** n. sp.

Glabrous with the exception of the hairs on the upper surface of the young leaves and on the calyx-lobes. Leaves oblong-obovate, acute or rounded at the apex, gradually narrowed to the slender concave-cuneate entire base, and finely serrate above the middle, with incurved glandular teeth; nearly fully grown when the flowers open in the first week of May and then very thin, dark yellow-green and slightly hairy on the midribs above and pale bluish green below, and at maturity thick to subcoriaceous, dark yellow-green and very lustrous on the upper surface and pale bluish green on the lower surface, 4–5 cm. long and 2–3 cm. wide, with slender yellow midribs, and thin primary veins within the parenchyma; petioles stout, wing-margined to below the middle, often rose color in the autumn, 6–7 mm. in length. Flowers 1.4–1.5 cm. in diameter, on long slender pedicels, in wide mostly 10- to 12-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, glabrous, the lobes gradually narrowed from the base, wide, long, green and acuminate at the apex, irregularly glandular-dentate, glabrous on the outer, slightly villose on the inner surface, reflexed after anthesis; stamens 10; anthers

pale yellow; styles 1 or 2, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening and falling at the end of September, on slender drooping pedicels, in few-fruited clusters, broader than high, truncate at the ends, slightly angled, dark crimson, lustrous, marked by occasional large pale dots, 1.2–1.3 cm. in diameter; calyx little enlarged, with a deep narrow cavity, and erect and slightly incurved green persistent lobes; flesh thin, light yellow-green, solid, rather juicy; nutlets 2, rounded and obtuse at the ends, ridged on the back, with a broad low slightly grooved ridge, 7–8 mm. long, and about 4 mm. wide, or when 1, 5–6 mm. in diameter.

A tree 5–6 m. high, with a tall trunk 1.5–1.8 dm. in diameter, covered with light red-brown scaly bark, large spreading branches forming a broad flat-topped head, and stout nearly straight branchlets light orange-green and marked by pale lenticels when they first appear, becoming light olive-green at the end of their first season and dull gray-brown the following year, and armed with stout straight or slightly curved chestnut-brown ultimately dull gray spines 2–5 cm. long.

Dry limestone hills, Pacific, Franklin County, *J. H. Kellogg* (No. 1 type), May 8, 1905, *J. H. Kellogg* and *C. S. Sargent*, September 29, 1907, (No. 5) *J. H. Kellogg*, May 8, 1905.

12. **Crataegus ferox,** n. sp.

Glabrous with the exception of a few caducous hairs on the upper surface of the young leaves. Leaves oblong-obovate, rounded or acute at the apex, gradually narrowed to the entire base, and finely doubly serrate above, with incurved glandular teeth; nearly half-grown when the flowers open the middle of May and then thin, dark green and shining above and pale below, and at maturity dark green and lustrous on the upper surface, pale on the lower surface, 4–5 cm. long and 2.5–3 cm. wide, with stout midribs often rose-colored in the autumn, and obscure primary veins mostly within the parenchyma; petioles stout, wing-margined nearly to the base, 5–6 mm. in diameter; leaves on vigorous shoots broadly obovate, acute or rounded at the apex, more coarsely serrate, often 6–7 cm. long and 5–6 cm. wide. Flowers 1.2–1.3 cm. in diameter, on slender pedicels, in wide lax mostly 7–12-flowered corymbs, the long slender lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes short, slender, acuminate, entire or occasionally dentate near the middle, reflexed after anthesis; stamens 10; anthers pale yellow; styles 1 or 2, surrounded at the base by a narrow ring of pale hairs. Fruit ripening the end of October, on slender spreading or drooping pedicels, in few-fruited clusters, subglobose to short-oblong or often slightly obovate, scarlet, frequently flushed with yellow, lustrous, marked by large dark dots, 1.2–1.4 cm. long, 1–1.2 cm. in diameter; calyx little enlarged, with a shallow narrow

cavity, and small spreading and incurved lobes, their tips often deciduous from the ripe fruit; flesh thin, yellow, dry and mealy; nutlets 1 or 2, full and rounded at the ends, ridged on the back, with a broad grooved ridge, 6–7 mm. long, and 4–4.5 mm. wide, or when 1, 5–5.5 mm in diameter.

A shrub 5–8 m. high, with several large slightly spreading stems, covered with dark scaly bark, spreading branches forming a broad round-topped head, and stout zigzag branchlets light orange-brown when they first appear, becoming rather darker orange-brown, slightly lustrous and marked by large pale lenticels in their first season, and dull gray-brown the following year, and armed with very numerous slender slightly curved purple spines 4–8 cm. long, usually pointed toward the base of the branch, and persistent and compound on old stems and branches.

Hillsides, Prosperity Junction, near Webb City, Jasper County, *B. F. Bush* (No. 3 A or 534 type), May 19, 1901, *E. J. Palmer*, Oct. 27, 1901, *B. F. Bush* (No. 3 or 533), May 19, 1901, *E. J. Palmer* and *C. S. Sargent*, Oct. 2, 1901, *B. F. Bush* (No. 3 D or 537), May 19, 1901, *E. J. Palmer* (No. 3 G), Oct. 27, 1901, *B. F. Bush* (No. 3 H or 541), May 19, 1901, *E. J. Palmer*, Oct. 27, 1901, *B. F. Bush* (No. 3 I or 542), May 19, 1901, *E. J. Palmer*, (No. 27) August 8, 1906, May 9 and 14 and October 4, 1907, (No. 27 C) October 13 and November 13, 1907; Neck City, Jasper County, *E. J. Palmer*, (Nos. 10, 10 A, 10 B) April 28, 1907, (No. 13) April 28 and October 4, 1907.

13. **Crataegus albanthera,** n. sp.

Glabrous with the exception of a few hairs on the upper side of the midribs of the young leaves. Leaves oblong-obovate, rounded or rarely acute at the apex, gradually narrowed from near the middle to the concave-cuneate entire base, and finely doubly serrate above, with straight glandular teeth; nearly fully grown when the flowers open from the first to the middle of May and then light yellow-green, lustrous and slightly hairy along the midribs above and pale below, and at maturity subcoriaceous, dark yellow-green and lustrous on the upper surface, pale bluish green on the lower surface, 3.5–4.5 cm. long and 1.5–2.5 cm. wide, with thin midribs, and very slender generally prominent primary veins; petioles stout, wing-margined nearly to the base, often tinged with rose color in the autumn, 7–8 mm. in length. Flowers about 1.5 cm. in diameter, on short slender pedicels, in small compact mostly 7–12-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes short and

broad, minutely glandular-dentate, tinged with rose color, reflexed after anthesis; stamens 10; anthers white or white faintly tinged with yellow; styles 2. Fruit short-oblong, or sometimes slightly obovate, rounded at the ends, dull crimson, 7–8 mm. in diameter; calyx little enlarged, with a deep narrow cavity, and spreading slightly incurved lobes; flesh thin, green, dry and hard; nutlets 2, rounded at the ends, slightly ridged on the back, about 5 mm. long, and 3 mm. wide.

A tree sometimes 7 m. high, with a trunk 1.2–1.5 dm. in diameter, and slender often contorted branchlets dark green tinged with red and marked by pale lenticels when they first appear, becoming light chestnut-brown in their first season and dull reddish brown the following year, and armed with slender straight or slightly curved ashy gray spines 2.5–3.5 cm. long.

Rocky hills and glades, Swan, Taney County, *B. F. Bush* (No. 21 A type), April 24 and October 7, 1907, (No. 21) April 24, 1907.

14. **Crataegus pachyphylla,** n. sp.

Glabrous with the exception of the hairs on the upper surface of the young leaves. Leaves obovate, acute, rounded and short-pointed or acuminate at the apex, gradually narrowed to the concave-cuneate entire base, and coarsely often doubly serrate above the middle, with straight or incurved glandular teeth; nearly half-grown when the flowers open in the first week of May and then thin, yellow-green, smooth, lustrous and slightly hairy along the midribs above and paler below, and at maturity coriaceous, yellow-green, glabrous and very lustrous on the upper surface, pale yellow-green on the lower surface, 4–6 cm. long and 2–3 cm. wide, with stout midribs, and thin prominent primary veins; petioles slender, wing-margined nearly to the base, often rose color in the autumn, 7–12 mm. in length; leaves on vigorous shoots broadly obovate, rounded and frequently short-pointed at the apex, and often 6–7 cm. long and 4–5 cm. wide. Flowers about 1.2 cm. in diameter, on long slender pedicels, in mostly 10–12-flowered crowded corymbs, the much elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from the base, long, slender, acuminate, entire or minutely dentate near the middle, reflexed after anthesis; stamens 10; anthers large, pale yellow; styles 2 or 3. Fruit ripening and falling early in October, on long stout drooping stems, in few-fruited clusters, short-oblong, truncate at the ends, depressed at the insertion of the pedicels, scarlet, very lustrous, marked by many large dark dots, 1.5–1.7 cm. long and 1.4–1.5 cm. in diameter; calyx little enlarged, with a deep narrow cavity pointed in the bottom, and small spreading usually deciduous lobes; flesh thick, light yellow-green, hard and bitter; nutlets 2 or 3, gradually

narrowed and rounded at the ends, prominently ridged on the back, with a broad high deeply grooved ridge, 8–8.5 mm. long, and 4.5–5 mm. wide.

A tree 5 or 6 m. high, with a tall trunk 1.5–2 dm. in diameter, covered with pale gray scaly bark, small short spreading branches forming a narrow round-topped head, and slender nearly straight branchlets light orange-green and marked by pale lenticels when they first appear, becoming light reddish brown and lustrous in their first season and dull red-brown the following year, and armed with many slender slightly curved chestnut-brown spines 4–7 cm. long.

Low moist soil, Osage, Cole County, *J. H. Kellogg*, (No. 7 type), May 5, 1905, May 6 and October 1, 1907.

15. **Crataegus candens,** n. sp.

Glabrous with the exception of the hairs on the young leaves. Leaves oblong-obovate, acuminate or rarely rounded at the apex, gradually narrowed to the long entire cuneate base, and finely serrate usually only above the middle, with straight glandular teeth; tinged with red when they unfold, more than half grown when the flowers open the middle of May and then thin, dark yellow-green, very lustrous and sparingly villose along the midribs above and paler and glabrous below, and at maturity subcoriaceous, glabrous, dark green and lustrous on the upper surface, pale bluish green on the lower surface, 4.5–6 cm. long and 2.5–3.5 cm. wide, with thin midribs, and slender primary veins within the parenchyma; petioles stout, narrow-wing-margined nearly to the base, occasionally glandular, with minute deciduous glands, 7–8 mm. in length; leaves on vigorous shoots thicker, more coarsely serrate, and often 7–8 cm. long and 3.5–4 cm. wide, with stout midribs and prominent primary veins. Flowers 1.2–1.4 cm. in diameter, on long slender pedicels, in wide lax mostly 12–16-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from the base, long, slender, acuminate and glandular at the apex, entire or occasionally dentate below the middle, reflexed after anthesis; stamens 5–8, usually 5 or 6; anthers pale yellow; styles 1 or 2. Fruit ripening early in October, on slender drooping pedicels, in few-fruited clusters, and usually persistent longer than the leaves, short-oblong, full and rounded at the ends, dark red, marked by numerous large pale dots, 1.2–1.5 cm. long and 1–1.2 cm. in diameter; calyx little enlarged, with a narrow deep cavity, and small spreading appressed lobes; flesh thin, green, dry and hard; nutlets 1 or 2, slightly narrowed and rounded at the apex, obtuse and rounded at the base, ridged on the back, with a broad low slightly grooved ridge, 7–8 mm. long, and 4–4.5 mm. wide, or when 1, 6–6.5 mm. in diameter.

A tree 5–9 m. high, with a trunk 7.5–15 cm. in diameter, covered with dark scaly bark, small spreading branches forming a flat-topped head, and stout slightly zigzag branchlets dark orange-green and marked by numerous pale lenticels when they first appear, becoming dull orange-brown in their first season and light gray-brown the following year, and armed with few slender straight or slightly curved purple shining spines 2.5–3 cm. long.

Gravelly banks of small streams, Monteer, Shannon County, common; *B. F. Bush* (No. 6 B type), May 14 and October 6, 1905, (No. 6) May 15 and October 3, 1905, May 26, 1907, (No. 6 A) May 12 and October 3, 1905, (No. 6 C) May 27, 1907; Grandin, Carter County, *B. F. Bush* (No. 2) May 8 and October 11, 1905, (Nos. 2 A, 2 B and 2 C) May and October 1905.

16. **Crataegus monosperma,** n. sp.

Glabrous with the exception of the hairs on the young leaves and calyx-lobes. Leaves narrowly obovate, acute, acuminate or rarely rounded at the apex, gradually narrowed and concave-cuneate at the slender acuminate entire base, and sharply serrate above, with long straight glandular teeth; nearly fully grown when the flowers open from the 10th to the middle of May and then thin, dark yellow-green, very lustrous and slightly villose along the midribs above and pale bluish green and glabrous below, and at maturity subcoriaceous, dark green and very lustrous on the upper surface, paler and bluish green on the lower surface, 5–6 cm. long and 2.5–3 cm. wide, with prominent yellow midribs, and very slender mostly prominent primary veins; petioles stout, narrow-wing-margined nearly to the base, 6–7 mm. in length; leaves on vigorous shoots ovate to slightly obovate, acute, rounded or abruptly pointed at the apex, coarsely doubly serrate, and often 7–8 cm. long and 4.5–5 cm. wide. Flowers about 1.5 cm. in diameter, on long slender pedicels, in wide lax mostly 10–12-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes long, slender, acuminate, minutely dentate, very sparingly villose on the inner surface, reflexed after anthesis; stamens 10; anthers pale yellow; styles 1 or rarely 2. Fruit ripening early in October, on long slender drooping pedicels, in few-fruited clusters, oval to ovate, dull red, marked by numerous pale dots, 1–1.1 cm. long and 9–10 mm. in diameter; calyx prominent, with a deep narrow cavity, and erect and incurved persistent lobes; flesh thin, yellowish green, dry and hard; nutlet 1, acute at the apex, full and rounded at the base, slightly 2-ridged, 7.5–8 mm. long, and 5–6 mm. in diameter.

A tree sometimes 7 m. high, with a tall trunk 1.5–2 dm. in diameter, covered with dark scaly bark, small erect branches forming an open irregular head, and slender nearly straight branchlets deeply tinged with red and marked by numerous pale lenticels when they first appear, becoming darker-colored in their first season and light ashy gray the following year, and armed with thin nearly straight purplish spines 3.5–4 cm. long.

Swan Creek bottoms near Swan, Taney County, *B. F. Bush* (No. Q type), May 20 and October 7, 1907.

17. **Crataegus truncata**, n. sp.

Glabrous with the exception of a few hairs on the upper side of the midribs of the young leaves and on the calyx-lobes. Leaves oblong-obovate, rounded, truncate and abruptly short-pointed or slightly obcordate at the broad apex, or rarely acuminate, gradually narrowed to the slender concave-cuneate entire base, and finely glandular-serrate usually only above the middle, with incurved glandular teeth; more than half-grown when the flowers open from the 10th to the middle of May and then thin, yellow-green and slightly villose along the midribs above and pale below, and at maturity thin and firm to subcoriaceous, yellow-green and very lustrous on the upper surface, pale yellow-green on the lower surface, 4–5 cm. long and 2–3.5 cm. wide, with prominent pale yellow midribs, and thin primary veins mostly within the parenchyma; petioles slender, narrow-wing-margined to below the middle, 5–7 mm. in length. Flowers about 1.5 cm. in diameter, on slender pedicels, in small compact 5–15-flowered corymbs, the long lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes slender, acuminate and glandular at the apex, entire or slightly glandular-serrate near the middle, very sparingly villose on the inner surface, reflexed after anthesis; stamens 10 or sometimes 5–8; anthers yellow; styles 1 or 2, usually 2. Fruit ripening the end of September, on long slender reddish drooping pedicels, in few-fruited clusters, short-oblong to slightly obovate, rounded at the ends, crimson, lustrous, marked by numerous pale dots, 1–2 cm. long, 8–10 mm. in diameter; calyx little enlarged, with a deep narrow cavity, and small spreading persistent lobes; flesh thin, green and dry; nutlets usually 2, narrowed and rounded at the base, obovate and rounded at the broader apex, slightly ridged on the back, 6–6.5 mm. long, and 3–3.5 mm. wide.

A tree 8–12 m. high, with a trunk 7–15 cm. in diameter, spreading branches forming a broad round-topped head, and slender nearly straight branchlets light orange-brown and marked by large pale lenticels when they first appear, becoming light chestnut-brown and lustrous in their first season and

dull gray-brown the following year, and armed with stout straight or slightly curved purplish shining ultimately ashy gray spines 2.5–4 cm. long.

Rocky hills and glades, Swan, Taney County, *B. F. Bush* (No. 13 type), May 21 and Sept. 22, 1905, May 16, 1907, (No. 13 A) May 16, and October 7, 1907.

This species is remarkable in the shape of the leaves which are generally broad and frequently truncate or obcordate at the apex.

18. **Crataegus tenuispina,** n. sp.

Glabrous with the exception of a few hairs on the upper side of the midribs of the young leaves. Leaves oval to slightly obovate, acute or acuminate at the ends, and coarsely serrate above the middle, with incurved glandular teeth; faintly tinged with red when they unfold, almost fully grown when the flowers open about the 1st of May and then thin, yellow-green and very lustrous above and paler below, and at maturity subcoriaceous, dark green and lustrous on the upper surface, light yellow-green on the lower surface, 4–6 cm. long and 1.5–2.5 cm. wide, with stout yellow midribs, and thin prominent primary veins deeply impressed on the upper side of the leaf; petioles slender, narrowly wing-margined to below the middle, often rose color in the autumn, 7–8 mm. in length; leaves on vigorous shoots thicker, broadly ovate or obovate, more coarsely serrate, sometimes 6–6.5 cm. long and 4–4.5 cm. wide. Flowers 1.2–1.3 cm. in diameter, on slender pedicels, in wide lax mostly 10–15-flowered corymbs, the long thin lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes slender, acuminate and glandular at the apex, entire or slightly dentate near the middle, reflexed after anthesis; stamens 10; anthers small, pale yellow; styles 2 or 3, surrounded at the base by a narrow ring of pale hairs. Fruit ripening early in October, on slender spreading and drooping pedicels, in few-fruited clusters, subglobose to short-oblong, crimson, lustrous, marked by large pale dots, 9–10 mm. in diameter; calyx little enlarged, with a deep narrow cavity, and small spreading lobes often deciduous from the ripe fruit; flesh thin, yellow-green, dry and mealy; nutlets 2 or 3, full and rounded at the ends, ridged on the back, with a broad grooved ridge, 6–7 mm. long, and 3.5–4 mm. wide.

A tree 7–10 m. high, with a trunk often 1.2 dm. in diameter, covered with dark scaly bark, small spreading and ascending branches forming a broad head, and slender nearly straight branchlets dark purple and marked by large pale lenticels when they first appear, becoming light chestnut-brown and lustrous in their first season and pale reddish brown the fol-

lowing year, and unarmed or armed with occasional small slender nearly straight chestnut-brown shining spines 1–1.5 or occasionally 2 cm. long.

Gravelly banks of small streams near Grandin, Carter County, *B. F. Bush* (Nos. 394, 404, 405, 406, 407), May 8, 1901, (No. 5 type) May 6 and Oct. 11, 1905, (No. 5 A) May 7 and Oct. 10, 1905.

Crataegus tenuispina is well distinguished from the other Crus-galli species by its narrow acuminate leaves and by its small weak and infrequent spines.

19. CRATAEGUS PALMERI Sargent, Trees and Shrubs, i. 57, t. 29 (1903); Manual, 381, f. 300.

Dry bark, and near streams in rich moist soil, Webb City and Carthage, Jasper County.

20. **Crataegus rotunda,** n. sp.

Glabrous with the exception of a few caducous hairs on the upper surface of the young leaves and on the inner surface of the calyx-lobes. Leaves obovate-cuneate, acute or rounded at the apex, and coarsely serrate above the middle, with straight or incurved glandular teeth; more than half-grown when the flowers open the middle of May and then thin, yellow-green and lustrous above and pale below, and at maturity subcoriaceous, dark yellow-green, smooth and very lustrous on the upper surface, pale yellow-green on the lower surface, 3.5–4 cm. long and 2–2.5 cm. wide, with thin midribs, and slender prominent primary veins; turning in the autumn bright clear yellow before falling; petioles stout, wing-margined to below the middle, occasionally glandular, 1.2–1.4 cm. in length; leaves on vigorous shoots coriaceous, broadly ovate to orbicular, short-pointed, very coarsely serrate, occasionally slightly lobed, 5–7 cm. in diameter, with broad-winged glandular petioles and foliaceous lunate coarsely serrate persistent stipules. Flowers 1.2–1.3 cm. in diameter, on long slender pedicels, in mostly 7–10-flowered corymbs, the elongated slender lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes slender, acuminate, entire, slightly villose on the inner surface, reflexed after anthesis; stamens 20; anthers pink; styles 2–4, usually 3. Fruit ripening from the first to the middle of November, on slender drooping stems, in generally 1–5-fruited clusters, subglobose or often rather broader than high, light cherry-red, 1.3–1.5 cm. in diameter; calyx prominent, with a short tube, a broad deep cavity, and nearly triangular spreading lobes often deciduous from the ripe fruit; flesh thick, pale yellow-green, dry and mealy; nutlets 3–5, gradually narrowed and rounded at the ends, rounded and grooved or slightly ridged on the back, 5.5–7 mm. long, and 4.5–5 mm. wide.

A tree 5–6 m. high, with a trunk 2–3 dm. in diameter, covered with dark scaly bark, spreading branches forming a wide flat or round-topped head, and stout zigzag branchlets light orange-yellow when they first appear, becoming bright chestnut-red, very lustrous and marked by large pale lenticels in their first season and light reddish brown the following year, and armed with many stout or slender nearly straight light chestnut-brown shining spines 2–4 cm. long, persistent and becoming compound on old stems and branches.

Prairies near Webb City, Jasper County, *E. J. Palmer*, (No. 21 type) November 3, 1901, May 16, 1903; Prosperity Junction, near Webb City, *B. F. Bush*, (No. 2 B) May 19, 1901, *E. J. Palmer*, Oct. 27, 1901, (No. 2, with 10–15 stamens) *E. J. Palmer* and *C. S. Sargent*, Oct. 2, 1901, *E. J. Palmer* Oct. 22, 1901, May 6, 1902; Joplin, Jasper County, *E. J. Palmer*, (No. 3) Oct. 13, 1907; common.

21. **Crataegus parciflora**, n. sp.

Glabrous with the exception of a few hairs on the upper side of the midribs of the young leaves and petioles, and on the calyx-lobes. Leaves broadly obovate to ovate, rounded or acute at the apex, abruptly or gradually concave-cuneate at the entire base, and finely doubly serrate usually to below the middle, with straight glandular teeth; very thin and conspicuously pale yellow when they unfold, not more than one-third grown when the flowers open during the first week of May and then thin, yellow-green above and pale bluish green below, and at maturity subcoriaceous, light yellow-green and lustrous on the upper surface, paler on the lower surface, 4–5 cm. long and 3–4.5 cm. wide, with prominent yellow midribs, and very thin prominent primary veins; petioles slender, narrow-wing-margined to below the middle, often rose-colored in the autumn, 1–1.2 cm. in length; leaves on vigorous shoots coriaceous, ovate or oval, rounded or acute and short-pointed at the apex, abruptly cuneate at the base, coarsely serrate, occasionally slightly lobed, often 5.5–6 cm. long and nearly as broad. Flowers 1.4–1.5 cm. in diameter, on slender pedicels, in mostly only 5- or 6-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes slender, acuminate, entire or minutely glandular-serrate, villose on the inner surface, reflexed after anthesis; stamens 20; anthers rose color; styles 3–5. Fruit ripening the end of October, on slender drooping pedicels, in usually 2–5-flowered clusters, short-oblong, full and rounded at the ends, pale cherry-red, marked by large dark dots, 9–10 mm. long and 8–9 mm. in diameter; calyx little enlarged, with a broad shallow cavity, and spreading sometimes slightly incurved persistent lobes; flesh thin, yellow-green, dry

and mealy; nutlets 3–5, thin, narrowed and rounded, or when 5 acute at the ends, slightly ridged on the back, with a thin grooved ridge, 5–5.5 mm. long, and about 3 mm. wide.

A tree 4–5 m. high on dry hills or 7 or 8 m. high on moist bottoms, with a trunk 1.5–3 dm. in diameter, covered with dark scaly bark, small horizontal branches forming a round-topped head, and stout slightly zigzag branchlets light orange-green when they first appear, becoming light chestnut-brown, lustrous and marked by small pale lenticels in their first year and dark red-brown in their second season, and armed with numerous slender nearly straight light chestnut-brown shining spines 2.5–5 cm. long.

Dry rocky hillsides, and in rich soil near small streams, Prosperity Junction, near Webb City, Jasper County, *E. J. Palmer* and *C. S. Sargent* (No. 1 type), Oct. 2, 1901, *E. J. Palmer*, Oct. 27, 1901, May 6, 1902.

This species is unusual in the Crus-galli group in its few-flowered corymbs, and in the number of styles, which are often 5. The small thin nutlets are also unusual in this group.

22. **Crataegus jasperensis** n. sp.

Glabrous with the exception of the hairs on the upper surface of the young leaves and on the calyx-lobes. Leaves broadly ovate to obovate, rounded or acute and short-pointed at the apex, gradually narrowed to the concave-cuneate entire base, and finely often doubly serrate above the middle, with straight or incurved glandular teeth; nearly fully grown when the flowers open the middle of May and then thin, yellow-green, smooth, lustrous, and slightly hairy on the midribs above and pale below, and at maturity subcoriaceous, glabrous, yellow-green and lustrous on the upper surface, pale bluish green on the lower surface, 4–5 cm. long and 2–3 cm. wide, with thin midribs, and slender primary veins mostly within the parenchyma; petioles slender, narrow-wing-margined nearly to the base, often rose color in the autumn, 6–7 mm. in length; leaves on vigorous shoots thicker, oval to ovate, short-pointed, coarsely serrate nearly to the base, often 5 cm. long and 4 cm. wide, with stout broadly winged petioles. Flowers 1.6–1.8 cm. in diameter, on long slender pedicels, in wide many-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from the base, slender, acuminate, entire or minutely glandular-dentate, glabrous on the outer, sparingly villose on the inner surface, reflexed after anthesis; stamens 20; anthers pale yellow; styles 4, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening late in October, on slender

erect or spreading pedicels, in few-fruited clusters, subglobose, crimson, marked by large pale dots, 8–9 mm. in diameter; calyx little enlarged, with a deep narrow cavity, and small spreading lobes dark red on the upper side; flesh thin, yellow-green, dry and hard; nutlets 4, gradually narrowed and rounded at the ends, slightly ridged on the back, 5.5–6 mm. long, and 2.5–3 mm. wide.

A tree, with slender nearly straight branchlets dark orange-red and marked by pale lenticels when they first appear, becoming bright chestnut-brown and lustrous in their first season and dull reddish brown the following year, and armed with stout nearly straight dark chestnut-brown spines 4.5–5.5 cm. long.

Near Webb City, Jasper County, *E. J. Palmer* (No. 2 X type), May 15, 1904, October 1907.

23. Crataegus Engelmanni Sargent, Bot. Gazette, xxxi. 2 (1901); Silva N. Am. xiii. 43, t. 639; Manual, 378, f. 297.

Kimmswick, Jefferson County, *G. Engelmann*, 1860; near Allenton, St. Louis County, and Pacific, Franklin County.

24. **Crataegus hirtella, n. sp.**

Leaves oblong-obovate, rounded or acute at the apex, gradually narrowed to the slender concave-cuneate entire base, and finely often doubly serrate above, with straight or incurved glandular teeth; deeply tinged with red and covered with long soft white hairs when they unfold, about half-grown when the flowers open from the 10th to the middle of May and then yellow-green, lustrous, setose, and villose along the midribs above and pale and hirsute on the base of the midribs below, and at maturity subcoriaceous, yellow-green and scabrate on the upper surface, pale yellow-green on the lower surface, 3–4 cm. long and 1.5–2 cm. wide, with prominent yellow still hairy midribs, and thin primary veins; petioles stout, narrow-wing-margined nearly to the base, villose especially while young, 6–7 mm. in length; leaves on vigorous shoots long-pointed and acuminate, thicker, more coarsely serrate, 5–6 cm. long and 2.5–3 cm. wide, with stouter midribs and petioles, and more prominent primary veins. Flowers 1.3–1.5 cm. in diameter, on long slender slightly villose pedicels, in compact mostly 6–12-flowered hairy corymbs, the long lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, glabrous, the lobes slender, tipped with bright red glands at the acuminate apex, entire, or minutely dentate near the middle, glabrous on the outer, villose on the inner surface, reflexed after anthesis; stamens 10; anthers pale salmon color; styles 1–3. Fruit ripening early in October, on long slender slightly hairy reddish pedicels, in few-fruited clusters, subglobose to short-oblong,

full and rounded at the ends, green tinged with red, about 1 cm. in diameter; calyx little enlarged, with a broad deep cavity, and small spreading and ascending lobes; flesh thin, green, dry and hard; nutlets 1–3.

A tree 4–5 m. high, with a trunk 1.5–1.8 dm. in diameter, covered with dark scaly bark, large spreading branches forming a wide round-topped head, and stout nearly straight branchlets, dull brown, slightly hairy and marked by large pale lenticels when they first appear, becoming light chestnut-brown, lustrous and glabrous in their first season and light gray tinged with red the following year, and armed with numerous stout straight light red-brown ultimately gray spines 4–6 cm. long.

Dry rocky hills near Swan, Taney County, *B. F. Bush* (No. 6 type), September 25, 1905, May 6 and October 7, 1907, (Nos. 6 B, 6 C and 6 D) May 16, 1907.

25. **Crataegus barbata,** n. sp.

Leaves oblong-obovate, acute or rarely rounded at the apex, gradually narrowed to the concave-cuneate entire base, and finely serrate above the middle, with straight glandular teeth; when the flowers open the middle of May thin, yellow-green, lustrous and roughened by short white hairs and villose along the midribs above, and pale and villose below along the midribs and veins. Flowers 1.2 cm. in diameter, on short hairy pedicels, in broad villose corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, coated with matted pale hairs, the lobes slender, acuminate, minutely dentate above the middle, glabrous on the outer, pubescent on the inner surface, reflexed after anthesis; stamens 10 or often only 5, 6 or 8; anthers pale salmon color; styles 2 or 3. Fruit ripening early in October, on slender slightly hairy drooping pedicels, in few-fruited clusters, subglobose to short-oblong, dark red, lustrous, marked by large pale dots, 8–9 mm. in diameter; calyx prominent, with a deep narrow cavity, and spreading nearly glabrous lobes; flesh thin, green, dry and hard; nutlets usually 2, narrowed and obtuse at the ends, slightly ridged on the back, 5–5.5 mm. long, and about 3 mm. wide.

A shrub 3–4 m. high, with small stems covered with dark bark, small horizontal branches forming a broad flat-topped head, and stout slightly zigzag branchlets light orange color and covered with long white hairs when they first appear, becoming glabrous and lustrous in their first season and light gray-brown the following year, and armed with stout slightly curved purple shining spines 3–3.5 cm. long.

Rocky hills and glades, near Swan, Taney County, *B. F. Bush* (No. 26 type), May 18 and October 7, 1907.*

26. **Crataegus pilifera,** n. sp.

Leaves oblong-obovate, rounded or acute at the apex, gradually narrowed and concave-cuneate at the entire often glandular base, and coarsely serrate above the middle, with straight or incurved glandular teeth; more than half-grown when the flowers open about the 20th of May and then thin, yellow-green and slightly hairy on the upper side of the midribs and veins, and sparingly villose on the midribs below, and at maturity subcoriaceous, dark green, very lustrous and nearly glabrous on the upper surface, and paler and glabrous on the lower surface, 3.5–4.5 cm. long and 1.7–2 cm. wide, with prominent yellow midribs, and obscure primary veins mostly within the parenchyma; petioles stout, narrowly wing-margined to below the middle, villose while young, becoming nearly glabrous, glandular, with minute glands, 6–7 mm. in length; leaves on vigorous shoots oval to slightly obovate, long-pointed and acuminate at the apex, thicker, more coarsely serrate, 5–6 cm. long and 2.5–3 cm. wide. Flowers 1.2–1.4 cm. in diameter, on long slender slightly villose pedicels, in lax hairy mostly 10–15-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, covered below with long white hairs, glabrous above, the lobes slender, acuminate and rose-colored at the apex, minutely dentate, glabrous on the outer, slightly villose on the inner surface, reflexed after anthesis; stamens 10; anthers pale yellow; styles 2 or 3. Fruit ripening early in October, on slender red slightly hairy pedicels, in few-fruited spreading clusters, short-oblong, full and rounded at the ends, dull red, marked by large pale dots, 1–1.2 cm. long and 9–10 mm. in diameter; calyx prominent, with a deep narrow cavity, and small spreading and reflexed lobes; flesh thin, yellow-green, dry and mealy; nutlets 2 or 3, gradually narrowed and rounded at the ends, ridged on the back, with a high grooved ridge, 6.5–7 mm. long, and 4–4.5 mm. wide.

A tree 5–8 m. high, with a trunk 8–20 cm. in diameter, large horizontal branches forming a wide flat-topped head, and stout slightly zigzag branchlets dull orange-green marked by large pale lenticels and villose when they first appear, becoming light chestnut-brown, lustrous and glabrous in their first season and light red-brown the following year, and armed with numerous slender nearly straight purplish shining spines 3–6 cm. long.

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* I have not seen the mature leaves of this species. When I visited the plants with Mr. Bush in October 1907 the old leaves had all disappeared and were replaced by young leaves.

Rocky hills and barrens near Swan, Taney County, *B. F. Bush*, (No. 7 type) May 21 and Sept. 23, 1905, (No. 7 A) Sept. 24, 1905, (No. 7 B) May 22 and Sept. 23, 1905; Chadwick, Christian County, *B. F. Bush*, (No. 1) May 14, 1907.

27. CRATAEGUS VILLIFLORA Sargent, Trees and Shrubs, ii. 61, t. 128 (1908).

Gravelly banks of streams, Grandin, Carter County, *B. F. Bush*, (No. 11 type) May and October, 1905; limestone hills, Pacific, Franklin County, *J. H. Kellogg*, (No. 3) May 8, 1905, October 1. 1907.

28. **Crataegus permera,** n. sp.

Glabrous with the exception of the hairs on the young leaves and on the calyx-lobes. Leaves oblong-obovate, usually rounded or acute and often short-pointed at the apex, gradually narrowed and cuneate at the base, and finely serrate above the middle, with straight or incurved glandular teeth; more than half grown when the flowers open about the middle of May and then thin, yellow-green and lustrous above and pale below, and at maturity thin, dark yellow-green and lustrous on the upper surface and pale yellow-green on the lower surface, 3.5–4.5 cm. long and 1.5–2 cm. wide, with thin yellow midribs, and obscure primary veins mostly within the parenchyma; petioles slender, narrowly wing-margined, 4–5 mm. in length. Flowers 1.2–1.3 cm. in diameter, on slender pedicels, in crowded compact mostly 8–10-flowered corymbs, the long slender lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes long, very slender, acuminate, entire or minutely dentate near the middle, sparingly villose on the inner surface, reflexed after anthesis; stamens 10; anthers rose color; styles 2 or 3, surrounded at the base by a narrow ring of white hairs. Fruit ripening the middle of October, on long drooping reddish pedicels, in few-fruited clusters, short-oblong, full and rounded at the ends, green more or less tinged with red, marked by large pale dots, 1–1.2 cm. long and 8–9 mm. in diameter; calyx little enlarged, with a broad shallow cavity, and small spreading and appressed lobes; flesh thin, greenish yellow, dry and mealy; nutlets 2 or 3, oblong, slightly narrowed and rounded at the ends, or when 3 acute at the base, ridged on the back, with a low slightly grooved ridge, 7–8 mm. long, and 4–4.5 mm. wide.

A tree 5–7 m. high, with a trunk 8–12 cm. in diameter, horizontal branches forming a wide flat-topped head, and slender nearly straight branchlets dark orange-brown and marked by large pale lenticels when they first appear, becoming light chestnut-brown and lustrous in their first season and

light gray-brown the following year, and armed with many slender straight or slightly curved purplish spines, 3–4.5 cm. long.

Rocky banks and hillsides near Monteer, Shannon County, *B. F. Bush* (No. 12 type), May 16 and Oct. 7, 1905, (No. 12 A) Oct. 7, 1905; Moark, on the boundary between Butler County and Arkansas, *B. F. Bush* (Nos. 2 A, 2 B, 2 C, 2 D), May and October, 1905; Butler County, *B. F. Bush* (No. 2) May 1 and October 16, 1905.

29. **Crataegus rubrifolia,** n. sp.

Glabrous with the exception of the hairs on the young leaves. Leaves short-obovate, acute or rounded at the apex, gradually narrowed to the concave-cuneate entire base, and finely often doubly serrate above the middle, with straight or incurved glandular teeth; when they appear bright red, roughened above by short white hairs and villose on the midribs above and glabrous below, nearly fully grown when the flowers open the end of April and then thin, light yellow-green and glabrous with the exception of a few hairs on the upper side of the midribs, and at maturity thin, yellow-green, lustrous and scabrate on the upper surface, paler on the lower surface, 2.5–3.5 cm. long and 1.5–2 cm. wide, with slender yellow midribs, and thin primary veins mostly within the parenchyma; petioles slender, narrow-wing-margined nearly to the base, villose on the upper side while young, becoming glabrous, 4–6 mm. in length; leaves on vigorous shoots oval to obovate or suborbicular, more coarsely serrate, often 4–5 cm. long and 3.5–4.5 cm. wide. Flowers 1.3–1.4 cm. in diameter, on long slender often red pedicels, in wide mostly 8–12-flowered corymbs, with linear acuminate bracts and bractlets fading brown and mostly deciduous before the flowers open, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes short, wide, acuminate and red at the apex, entire or minutely dentate near the middle, reflexed after anthesis; stamens 10; anthers pale pink; styles 3 or 4, usually 4. Fruit ripening the middle of October, on slender red pedicels, in few-fruited drooping clusters, subglobose, bright orange-red, lustrous, 8–9 mm. in diameter; calyx little enlarged, with a deep narrow cavity, and spreading often deciduous lobes; flesh thin, yellow, dry and mealy; nutlets usually 4, narrowed and rounded at the base, broader and rounded at the apex, ridged on the back, with a low narrow ridge, about 5 mm. long, and 3.5–4 mm. wide.

A tree in moist rich soil often 6–7 m. high, with a trunk sometimes 2.5 dm. in diameter, covered with thin dark scaly bark, with orange-colored inner layers, and slender slightly zigzag branchlets bright green more or less tinged with red

when they first appear, becoming bright chestnut-brown and rather lustrous in their first season and dull red-brown the following year, and armed with few slender straight purple spines 1.5–3 cm. long; or on dry rocky hills a shrub only 2–3 m. tall.

Jasper County; common and generally distributed, *E. J. Palmer*, Prosperity Junction, near Webb City, (No. 29 type) April 14 and October 4, 1907; bottom-lands of small streams south of Webb City, (No. 29 A) April 21, 1907; Joplin, (Nos. 5, 5 A) April 1907, (No. 5 B) April 7 and October 13, 1907; Carl Junction, (No. 4) April 14 and October 13, 1907.

30. **Crataegus consueta,** n. sp.

Glabrous with the exception of the hairs on the upper side of the midribs of the young leaves and on the calyx-lobes. Leaves oblong-obovate, rounded or occasionally acute at the apex, gradually narrowed from above the middle to the slender cuneate entire base, and coarsely often doubly serrate above, with straight glandular teeth; nearly fully grown when the flowers open the middle of May and then thin, dark yellow-green, lustrous and slightly hairy on the midribs above and pale below, and at maturity thin, glabrous, dark green and very lustrous on the upper surface, pale yellow-green on the lower surface, 3.5–4 cm. long and 2–2.5 cm. wide, with prominent yellow midribs, and thin prominent primary veins; petioles thin, narrow-wing-margined to below the middle, glabrous, 7–9 mm. in length; leaves on vigorous shoots oval to slightly obovate, rounded or acute and short-pointed at the apex, abruptly concave-cuneate at the base, more coarsely serrate, often 4.5–5 cm. long and 3.5–4 cm. wide, with stouter midribs and petioles, and more prominent primary veins. Flowers about 1.5 cm. in diameter, on very long slender pedicels, in lax drooping mostly 5- or 6-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes long, slender, acuminate and glandular at the apex, entire or occasionally minutely dentate, slightly pubescent on the inner surface, reflexed after anthesis; stamens 10; anthers rose color; styles 1 to 4. Fruit ripening the end of September, on long slender drooping pedicels, in few-fruited clusters, oval, orange-red, marked by large dark dots, 1–1.2 cm. long and 8–10 mm. in diameter; calyx little enlarged, with a deep narrow cavity, and small slender spreading or incurved persistent lobes; flesh thick, yellow-green, dry and hard; nutlets 1–4, gradually narrowed and rounded at the ends, or when 4 acute at the base, rounded and slightly ridged on the back, with a broad low ridge, 6–7 mm. long, and 3–4 mm. wide.

A tree 6–7 m. high, with a trunk 1–1.5 dm. in diameter, stout erect branches forming a narrow open irregular head,

and slender nearly straight branchlets light orange-brown and marked by numerous pale lenticels when they first appear, becoming light chestnut-brown and lustrous in their first season and darker the following year, and armed with slender straight or slightly curved purplish shining spines 3–4 cm. long.

Rocky hills, and glades, Swan, Taney County, *B. F. Bush*, (No. 6 A type), May 23 and Sept. 24, 1905, (No. 4 A) May 23 and Sept. 24, 1905, (No. 6 A) May 23 and Sept. 24, 1905, (No. 6 B, 6 C and 6 D) May 16, 1907, (No. 22) April 24 and October 7, 1907.

31. **Crataegus tenuisepala,** n. sp.

Glabrous with the exception of the hairs on the young leaves. Leaves obovate, rounded or acute and short-pointed at the apex, gradually narrowed and concave-cuneate at the entire base, and coarsely serrate above the middle, with straight or incurved glandular teeth; nearly fully grown when the flowers open at the end of April and then thin, yellow-green, smooth, lustrous and slightly hairy along the midribs above and pale and glabrous below, and at maturity thin, dark bluish green and lustrous on the upper surface, pale bluish green on the lower surface, 3.5–5.5 cm. long and 2.5–4 cm. wide, with slender yellow midribs, and thin prominent primary veins; petioles slender, narrow-wing-margined to the middle, slightly hairy on the upper side while young, soon glabrous, 5–12 mm. in length; leaves on vigorous shoots suborbicular to oval and abruptly short-pointed, and often 5–6 cm. long and broad. Flowers 1.3–1.4 cm. in diameter, on long slender pedicels, in lax mostly 5- or 6-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes long, very slender, acuminate and rose-colored at the apex, entire or irregularly glandular-dentate, reflexed after anthesis; stamens 15; anthers dark rose color; styles 2–4. Fruit ripening the middle of October, on slender drooping pedicels, in few-fruited clusters, short-oblong, full and rounded at the ends, orange-red, lustrous, marked by large dark dots, 9–10 mm. long and 8–9 mm. in diameter; calyx little enlarged, with a wide shallow cavity, and spreading or appressed usually persistent lobes; flesh thin, yellow, dry and mealy; nutlets usually 3, gradually narrowed and rounded at the ends, ridged on the back, with a broad low deeply grooved ridge, 5–5.5 mm. long, and about 3 mm. wide.

A tree 5-8 m. high, with a tall stem 1.5-2 dm. in diameter, and slender nearly straight branchlets dull chestnut-brown and marked by pale lenticels when they first appear, becoming very lustrous in their first season and dark reddish brown

the following year, and armed with numerous slender straight chestnut-brown spines 2.5–4 cm. long.

Gravelly ridges between swamps, Moark, on the boundary between Butler County and Arkansas, *B. F. Bush*, (No. 5 type) May 1 and October 15, 1905.

32. **Crataegus leptophylla,** n. sp.

Glabrous with the exception of the hairs on the upper surface of the young leaves. Leaves oblong-obovate, rounded or acute and often short-pointed at the apex, gradually narrowed to the slender cuneate base, and coarsely often doubly serrate above the middle, with straight or incurved glandular teeth; nearly fully grown when the flowers open in the first week of May and then thin, yellow-green, smooth, lustrous and slightly hairy on the midribs above and paler below, and at maturity thin but firm in texture, dark yellow-green, glabrous and lustrous on the upper surface, pale on the lower surface, 5–7 cm. long and 3–3.5 cm. wide, with prominent yellow midribs, and slender usually prominent primary veins; petioles stout, narrow-wing-margined nearly to the base, often rose color in the autumn, 8–10 mm. in length. Flowers about 1.2 cm. in diameter, on long slender pedicels, in wide mostly 10–15-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from the base, short, broad, acuminate and glandular at the apex, minutely glandular-dentate near the middle, reflexed after anthesis; stamens 20; anthers pink; styles 3–5. Fruit ripening and falling early in October, on long drooping red pedicels, in few-fruited clusters, short-oblong to slightly obovate, rounded at the ends, light orange-red, lustrous, marked by large pale dots, 1–1.2 cm. long and 8–10 mm. in diameter; calyx little enlarged, with a deep narrow cavity, and small spreading lobes; flesh very thin, green and hard; nutlets usually 3 or 4, gradually narrowed and rounded at the ends, ridged on the back, with a broad deeply grooved ridge, 4.5–5 mm. long, and 3–3.5 mm. wide.

A tree sometimes 7 m. high, with a tall trunk 2–2.5 dm. in diameter, covered with light red-brown bark separating into small closely appressed scales, large spreading and ascending branches forming an open irregular round-topped head, and stout slightly zigzag branchlets chestnut-brown and marked by numerous large pale lenticels when they first appear, becoming lustrous and dull reddish brown the following year and ultimately light gray, and armed with numerous slender straight or slightly curved purple shining spines 5–6 cm. long, and persistent, elongated and crowded on old stems and branches.

Low rich soil, Osage, Cole County, *J. H. Kellogg*, (No. 1 type) May 6, 1905, October 7, 1907, (Nos. 4, 5 and 6) May 6, 1905, October 7, 1907.

33. CRATAEGUS ACUTIFOLIA Sargent, Bot. Gazette, xxxi. 217 (1901); Silva N. Am. xiii. 51, t. 643; Manual, 375, f. 294.

River des Pères bottoms, Carondelet, St. Louis County.

34. **Crataegus rubrisepala,** n. sp.

Glabrous with the exception of the hairs on the young leaves. Leaves rhombic to oval or slightly obovate, acute at the apex, concave-cuneate at the entire base, and finely often doubly serrate above, with straight glandular teeth; nearly fully grown when the flowers open at the end of April and then thin, yellow-green and slightly hairy along the midribs above and pale and glabrous below, and at maturity thin, yellow-green and lustrous on the upper surface, dull yellow-green on the lower surface, 3–4 cm. long and 2.5–3 cm. wide, with slender yellow midribs, and thin prominent primary veins; petioles slender, narrow-wing-margined nearly to the base, often rose color in the autumn, 5–12 mm. in length; leaves on vigorous shoots oval to obovate, more coarsely serrate, often 5–6 cm. long and 3.5–4 cm. wide. Flowers 1.2–1.4 cm. in diameter, on long slender pedicels, in lax mostly 10–15-flowered corymbs, the much elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes long, slender, acuminate, entire or slightly glandular-dentate near the apex, bright rose color, reflexed after anthesis; stamens 10; anthers pale yellow; styles usually 3, surrounded at the base by a ring of pale tomentum. Fruit ripening the middle of October, on long slender red drooping pedicels, in few-fruited clusters, subglobose to short-oblong, full and rounded at the ends, orange-red, 7–8 mm. in diameter; calyx prominent, with a narrow deep cavity pointed and tomentose in the bottom, and erect and incurved persistent lobes; flesh thin, dry and mealy; nutlets 2 or 3, rounded at the apex, narrowed and acute at the base, rounded and slightly grooved on the back, 5–5.5 mm. long, and about 3 mm. wide.

A shrub 3–4 m. high, with intricately branched stems covered with dark gray scaly bark and forming an irregular round-topped head, and stout zigzag branchlets green more or less tinged with red when they first appear, becoming light chestnut-brown, lustrous and marked by large lenticels in their first season and dull reddish brown the following year, and armed with numerous stout nearly straight dark purple shining spines 3.5–4.5 cm. long.

Thickets on dry rocky hills along Turkey Creek north of Joplin, Jasper County, *E. J. Palmer*, (No. 8 type) April 28 and October 13, 1907.

Mr. Palmer notices that the disks of the flowers in this species turn dark purple-red as the flowers fade, an unusual change of color in this group, although it is common in plants of the Molles and Flabellatae Groups.

35. **Crataegus rudis,** n. sp.

Glabrous with the exception of the hairs on the upper side of the young leaves. Leaves oblong-obovate, rounded or rarely acute at the apex, gradually narrowed to the long slender cuneate entire base, very slightly serrate above the middle, with incurved glandular teeth, and thickened and slightly revolute on the margins; nearly fully grown when the flowers open about the 10th of May and then yellow-green, smooth and lustrous and slightly hairy along the midribs and veins above and paler below, and at maturity thin, yellow-green, glabrous and lustrous on the upper surface, pale bluish-green on the lower surface, 4–5 cm. long and 1.5–2 cm. wide, with slender yellow midribs, and very thin primary veins; petioles slender, narrow-wing-margined to below the middle, 4–5 mm. in length; leaves on vigorous shoots acute or rounded and short-pointed at the apex, more coarsely serrate and often 5–7 cm. long and 3–4 cm. wide, with stout midribs and petioles, and more prominent primary veins. Flowers 1.3–1.5 cm. in diameter, on long slender pedicels, in small lax mostly 7- to 12-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes abruptly narrowed from the base, long, slender, glandular and acuminate at the apex, entire or minutely glandular-dentate below the middle, reflexed after anthesis; stamens 10; anthers pale yellow; styles 1–3, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening and falling early in October, on long slender drooping pedicels, in few-fruited clusters, oval to subglobose, scarlet, slightly pruinose, marked by large dark dots, 1–1.2 cm. long, 9–10 mm. in diameter; calyx little enlarged, with a deep narrow cavity, and small spreading usually deciduous lobes; flesh thin, green, dry and hard; nutlets usually 1 or 2, gradually narrowed and rounded at the ends, ridged on the back, with a broad low grooved ridge, 5–6 mm. long, and 4–4.5 mm. wide, or when 1, 5.5–6 mm in diameter.

A tree 3–8 m. high, with a trunk 7.5–15 cm. in diameter, covered with dark scaly bark, and stout nearly straight branchlets light orange-green and marked by pale lenticels when they first appear, becoming light orange-brown in their first season and light gray and rather lustrous the following year, and armed with very numerous stout or slender

straight or slightly curved purple shining ultimately gray spines 3–6 cm. long.

Woods and the gravelly banks of small streams near Monteer, Shannon County, *B. F. Bush* (No. 2 type), May 11 and Oct. 8, 1905, (No. 2 A) Oct. 5, 1905, April 28, 1907, (No. 2 C)May 12 and Oct. 3, 1905, April 29, 1907, (No. 2 D) May 26, 1907, (No. 2 E) Oct. 7, 1905, (No. 4) May 12 and August 19, 1901, (No. 4 D) August 20, 1901.

36. CRATAEGUS ERECTA Sargent, Bot. Gazette, xxxi. 218 (1901); Silva N. Am. xiii. 49, t. 642; Manual, 375, f. 293.

Mississippi River bottoms, East St. Louis to Fish Lake, Illinois.

37. CRATAEGUS INSIGNIS Sargent, Trees and Shrubs, i. 107, t. 54 (1903).

Mississippi River bottoms near Cahokia, Illinois, *C. S. Sargent*, *J. B. S. Norton* and *J. H. Kellogg*, (No. 51) 1900-1902; East St. Louis, *J. H. Kellogg*, (No. 2 A) 1902-1904, (No. 14) 1902-1903.

38. **Crataegus setosa,** n. sp.

Leaves oblong-obovate, acuminate and short-pointed or occasionally rounded at the apex, gradually narrowed to the slender entire base, and finely serrate usually only above the middle, with straight or incurved glandular teeth; nearly fully grown when the flowers open during the first week of May and then thin, yellow-green and setose above, and pale and slightly villose along the midribs and veins below, and at maturity thin but firm in texture, yellow-green, smooth and lustrous on the upper surface and paler and nearly glabrous on the lower surface, 3–4 cm. long and 1.5–2.5 cm. wide, with slender yellow midribs, and thin primary veins mostly within the parenchyma; petioles slender, narrow-wing-margined, villose while young, becoming glabrous, 5–6 mm. in length; leaves on vigorous shoots thicker, oval to slightly obovate, abruptly long-pointed, more coarsely serrate and often 4–5 cm. long, with foliaceous falcate glandular-serrate stipules. Flowers 1.2–1.3 cm. in diameter, on slender pedicels covered with long white hairs, in compact slightly hairy mostly 6–8-flowered corymbs, the long slender lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, glabrous, the lobes slender, acuminate, entire or minutely glandular-dentate, glabrous on the outer, sparingly villose on the inner surface, reflexed after anthesis; stamens 10; anthers rose color; styles 2–4. Fruit ripening early in October, on slender drooping glabrous pedicels, in few-fruited clusters, subglobose or slightly longer than broad, crimson, lustrous, marked by large pale dots, 9–10 mm. in

diameter; calyx little enlarged, with a broad shallow cavity, and small spreading and appressed persistent lobes; flesh thin, yellow-green, dry and mealy; nutlets 2–4, full and rounded, or when 4, narrowed at the ends, ridged on the back, with a broad high only slightly grooved ridge, 6.5–7 mm. long, and 3.5–4 mm. wide.

A tree 5–8 m. high, with a trunk 7–15 cm. in diameter, large branches forming a broad round-topped head, and stout nearly straight branchlets purple marked by large pale lenticels and covered with matted white hairs when they first appear, becoming dark red-brown, lustrous and glabrous in their first season and dull gray-brown the following year, and armed with numerous slender nearly straight purplish shining spines 3.5–4.5 cm. long.

Gravelly borders of small streams near Grandin, Carter County, *B. F. Bush* (No. 6 B type), May 8 and Oct. 13, 1905, (No. 6) May 6 and Oct. 11, 1905, (No. 6 A) May 7 and Oct. 11, 1905.

Well distinguished by its small acute leaves setose above while young, its villose corymbs and small subglobose fruits.

39. Crataegus munita, n. sp.

Leaves oblong-obovate to oval, rounded or acute and sometimes short-pointed at the apex, concave-cuneate at the entire base, and coarsely crenately serrate above the middle; nearly half-grown when the flowers open in the first week of May and then thin, yellow-green, roughened above by short white hairs and villose on the upper side of the midribs and paler and glabrous below, and at maturity thin but firm in texture, dark yellow-green, very lustrous and scabrate or almost smooth on the upper surface, pale bluish green on the lower surface, 3–4 cm. long and 1–2.5 cm. wide, with prominent midribs, and thin prominent primary veins; petioles slender, slightly wing-margined nearly to the base, densely villose while young, becoming glabrous, often rose color in the autumn, 6–7 mm. long; leaves on vigorous shoots oblong-obovate, acuminate, rather thicker, coarsely doubly serrate, usually slightly lobed towards the apex, often 5–6 cm. long and 2.5–4.5 cm. wide, with stout rose-colored midribs, prominent primary veins and broad-winged petioles. Flowers 1.2–1.5 cm. in diameter, on slender densely villose pedicels, in compact mostly 6–8-flowered hairy corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, villose at the base, glabrous above, the lobes long, slender, acuminate and glandular at the apex, glabrous on the outer, villose on the inner surface, reflexed after anthesis; stamens 10; anthers rose color; styles 1 or 2, rarely 3. Fruit ripening late in October or early in November, on short erect or spreading villose red pedicels, in few-fruited

clusters, subglobose or a little longer than broad, scarlet, more or less pruinose, marked by large pale dots, 8–9 mm. in diameter; calyx prominent, with a short tube, a wide deep cavity, and spreading and incurved mostly persistent lobes; flesh thin, yellow-green, dry and hard; nutlets 1 or 2, acute at the base, rounded and obtuse at the apex, slightly ridged on the back, with a narrow low ridge, 4.5–5 mm. long, and about 2.5 mm. wide, or when 1, 4 mm. in diameter.

A shrub or small tree occasionally 5 m. high but often beginning to flower when less than 1 m. tall, large intricately branched stems, and stout zigzag branchlets dark orange-green and coated with long matted pale hairs when they first appear, becoming light chestnut-brown, lustrous and pubescent in their first season and light gray-brown the following year, and armed with very numerous stout straight or slightly curved purplish shining spines 4–5.5 cm. long.

Dry rocky hillsides near Webb City, Jasper County, *E. J. Palmer*, (No. 17 type) October 13 and November 3, 1901, May 4, 1902, (No. 17 A) November 3, 1901, (No. 17 B) May 4, 1902; Eagle Rock, Barry County, *B. F. Bush*, (No. 86) May 24, 1898.

40. **Crataegus vallicola,** n. sp.

Leaves oblong-obovate, rounded or acute and often short-pointed at the apex, gradually narrowed to the long slender concave-cuneate entire base, and finely serrate above the middle, with straight or incurved glandular teeth; more than half-grown when the flowers open from the 10th to the middle of May and then thin, dark yellow-green, smooth, lustrous and villose along the midribs above and paler and glabrous below, and at maturity thin, dark yellow-green, smooth, lustrous and still slightly hairy on the midribs on the upper surface, pale yellow-green on the lower surface, 4–5 cm. long and 2.5–3 cm. wide, with prominent midribs, and thin conspicuous primary veins; petioles slender, wing-margined nearly to the base, slightly hairy on the upper side, 8–9 mm. in length; leaves on vigorous shoots thicker, with stouter midribs and primary veins, and often 7–8 cm. long and 4–4.5 cm. wide. Flowers 1.4–1.5 cm. in diameter, on long slender slightly villose pedicels, in wide hairy 15–20-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, glabrous, the lobes gradually narrowed from the base, short, slender, entire or occasionally minutely dentate near the middle, glabrous on the outer, sparingly villose on the inner surface, reflexed after anthesis; stamens 10–15; anthers pale pink; styles 2 or 3, generally 2. Fruit ripening and falling late in September, on slightly hairy pedicels, in few-fruited spreading clusters, short-oblong,

full and rounded at the ends, dull crimson blotched with green, marked by large pale dots, 1.4–1.6 cm. in diameter; calyx little enlarged, with a deep narrow cavity pointed and tomentose in the bottom, and slender spreading and appressed lobes; flesh thin, yellow-green, dry and hard; nutlets usually 2, gradually narrowed and rounded at the ends, often rather broader at the apex than at the base, irregularly ridged on the back, with a low narrow sometimes grooved ridge, 8–8.5 mm. long, and 4.5–5 mm. wide.

A tree 7–8 m. high, with a tall stem sometimes 1.5 dm. in diameter, covered with dark scaly bark, small spreading branches forming an open irregular head, and slender nearly straight branchlets dark reddish brown, marked by large pale lenticels and covered with long scattered white hairs when they first appear, light green and still villose at the end of their first season, dull gray and glabrous the following year, and armed with stout straight or slightly curved dull gray spines 2.5–3 cm. in length, becoming compound, and persistent on old trunks and stems.

Wooded slopes in rich soil near Barrett's Station, St. Louis County, *J. H. Kellogg* (No. 1 type), May 9, 1902, May 8, 1905, May 13 and Sept. 28, 1907.

PUNCTATAE.

Leaves obovate to oval or rhombic, cuneate at the base, usually more or less lobed above the middle, thin to subcoriaceous, with prominent veins; petioles short; flowers large, in hairy corymbs; fruit globose to subglobose or rarely obovate, 1.2–5 cm. in diameter.

Anthers rose color; stamens 20.

Leaves rhombic to obovate, acute or rounded at the apex; flowers in mostly 9–12-flowered corymbs.

Flowers 2–2.2 cm. in diameter, in densely villose corymbs; fruit subglobose, flattened at the ends; mature leaves scabrate above.

1. *C. verruculosa.*

Flowers not more than 1.5 cm. in diameter, in slightly villose corymbs; fruit globose to short-oblong, rounded at the ends; mature leaves smooth above.

2. *C. sordida.*

Leaves narrow-obovate, acuminate; flowers not more than 1.2 cm. in diameter, in slightly villose 4–10-flowered corymbs; fruit subglobose, often broader than high; mature leaves smooth above.

3. *C. angustata.*

Anthers yellow.
Stamens 20 (15–20 in No. 6).
Leaves obovate to oval, blue-green; flowers not more than 1.5 cm. in diameter, in densely villose corymbs; fruit subglobose to short oblong, dull red, up to 1.2 cm. in diameter. 4. *C. vicina.*
Leaves obovate, yellow-green.
Leaves thin; flowers not more than 1.2 cm. in diameter, in slightly villose 4–7-flowered corymbs; fruit subglobose to short-oblong, orange-red, 7–9 mm. in diameter. 5. *C. succincta.*
Leaves subcoriaceous; flowers up to 1.8 cm. in diameter, in 8–10-flowered pubescent corymbs; fruit subglobose, bright red, 2–2.5 cm. in diameter. 6. *C. sucida.*
Stamens 15 (10–15 in Nos. 8 & 9).
Leaves rhombic to obovate, acute or acuminate; flowers up to 2 cm. in diameter, in 8–10-flowered corymbs; fruit subglobose to short-oblong. 7. *C. macropoda.*
Leaves obovate to oval; flowers 1.5–1.8 cm. in diameter.
Flowers in 15–20-flowered corymbs; fruit short-oblong; leaves broadly obovate, acute or acuminate at the apex. 8. *C. incaedua.*
Flowers in 5–7-flowered corymbs; fruit subglobose, sometimes broader than high; leaves oblong-obovate, acuminate or rounded at the apex. 9. *C. hertiflora.*
Stamens 10; leaves obovate, yellow-green, scabrate above; flowers 1.5 cm. in diameter, in compact 8–15-flowered corymbs; fruit subglobose to slightly obovate, dull orange-red, pubescent at the ends, 1.5 cm. in diameter. 10. *C. Lettermani.*
Stamens 5–8; leaves oblong-obovate, blue-green, scabrate above; flowers up to 2 cm. in diameter, in 5–8-flowered corymbs; fruit subglobose, 1–1.2 cm. in diameter. 11. *C. secta.*

1. CRATAEGUS VERRUCULOSA Sargent, Manual, 394, f. 313 (1905).

Springfield, Greene County.

2. CRATAEGUS SORDIDA Sargent, Bot. Gazette, xxxiii. 114 (1902); Silva N. Am. xiii. 75, t. 655; Manual, 395, f. 314.

Grandin, Pleasant Grove; and Monteer, Shannon County.

POLYGONUM IN RIVER BOTTOM.

3. **Crataegus angustata,** n. sp.

Leaves narrow-obovate, acuminate and occasionally abruptly short-pointed at the apex, gradually narrowed from above the middle to the long slender cuneate entire base, finely serrate above, with straight glandular teeth, and often slightly divided above the middle into 2 or 3 pairs of small lobes; more than half-grown when the flowers open from the 10th to the middle of April and then thin, dark yellow-green and covered above by short white hairs and paler and slightly villose along the midribs and veins below, and at maturity thin but firm in texture, dark yellow-green, smooth and lustrous on the upper surface, paler on the lower surface, 2.5–4 cm. long and 1.5–1.8 cm. wide, with prominent yellow midribs, and thin conspicuous yellow primary veins extending very obliquely toward the end of the leaf. Flowers about 1.2 cm. in diameter, on long slender villose pedicels, in narrow 4–10-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, pubescent, the lobes slender, acuminate and rose-colored at the apex, glandular-serrate above the middle, villose, reflexed after anthesis; stamens 20; anthers pale rose color; styles 4 or 5. Fruit ripening and falling at the end of September or early in October, on short nearly glabrous drooping pedicels, in few-fruited clusters, subglobose or often rather broader than high, crimson, more or less blotched with green, marked by large pale dots, 1.2–1.4 cm. in diameter; calyx prominent, with a broad deep cavity, and elongated spreading persistent lobes; flesh thick, green, hard and dry; nutlets 4 or 5, gradually narrowed and rounded at the ends, ridged on the back, with a narrow high ridge, 6–6.5 mm. long, and 3.5–4 mm. wide.

A much-branched round-topped shrub 3–5 m. high, with stout stems covered with dark scaly bark, small erect and spreading branches, and slender nearly straight branchlets hoary-tomentose when they first appear, becoming glabrous and light chestnut-brown in their first season and reddish brown the following year, and armed with very numerous slender straight or slightly curved gray spines 3.5–6 cm. long.

Gravelly banks of streams, Swan, Taney County, *B. F. Bush* (No. 1 type), April 20 and October 6, 1907; also (No. 1A) May 21, 1905, (No. 1 B) September 26, 1905, and (No. 1 E) April 22, 1907, all with leaves broader than those of the type and perhaps belonging to another species.

4. **Crataegus vicina,** n. sp.

Leaves obovate to oval, acute, acuminate or rounded at the apex, gradually narrowed to the cuneate entire base, slightly often doubly serrate above, with straight glandular teeth, and sometimes slightly lobed above the

middle; not more than a quarter-grown when the flowers open the first of April or late in March and then thin, yellow-green and roughened above by short white hairs and villose below, especially on the midribs and veins, and at maturity thin but firm in texture, dark blue-green, lustrous and smooth above and pale blue-green and more or less villose on the slender yellow midribs, primary veins and reticulate veinlets below, 5–6 cm. long and 3–3.5 cm. wide; petioles slender, narrow-wing-margined often to below the middle, 8–15 mm. in length; leaves on vigorous shoots thicker, broadly obovate, acute or acuminate at the apex, rounded or abruptly cuneate at the base, often 6–7 cm. long and 5 cm. wide. Flowers about 1.5 cm. in diameter, on long stout densely villose pedicels, in wide hairy mostly 7–10-flowered corymbs, the long lower peduncles from the axils of upper leaves; calyx-tube broadly obconic, thickly covered with long matted white hairs, the lobes gradually narrowed from the base, long, slender, acuminate, finely glandular-serrate, villose below and glabrous above on the outer surface, slightly villose on the inner surface, reflexed after anthesis; stamens 20; anthers pale yellow; styles 5. Fruit ripening late in September, on stout spreading hairy pedicels, in few-fruited drooping clusters, subglobose, often a little longer than wide, dull red, marked by conspicuous pale dots, 1–1.2 cm. in diameter; calyx prominent, with a very wide shallow cavity, and spreading often appressed coarsely serrate lobes densely villose on the upper side; flesh thick, yellow, smooth and edible; nutlets 5, thin, gradually narrowed and acute at the ends, rounded and slightly grooved on the back, 6–7 mm. long, and 5–5.5 mm. wide.

A tree 7–8 m. high, with a trunk 2–2.5 dm. in diameter, covered with dark scaly bark, stout spreading and ascending branches forming a wide open head, and stout slightly zigzag branchlets tinged with red, marked by large pale lenticels and villose when they first appear, becoming light orange-brown and lustrous in their first season and lighter reddish brown the following year, and armed with very numerous slender straight or slightly curved purplish shining ultimately dull gray spines 4–6 cm. long, persistent, very numerous and much-branched on old trunks and stems.

Hillsides in rich soil, Neck City, Jasper County, *E. J. Palmer*, (No. 4 type) August 17, 1902, April 15, 1903, (No. 4 A) July 29, 1906, March 31, 1907, (Nos. 4 B and 4 C) March 31, 1907.

5. **Crataegus succincta**, n. sp.

Leaves obovate, acute and short-pointed at the apex, gradually narrowed to the entire base, and finely serrate usually only above the middle, with straight or incurved glandular teeth; when they unfold covered with

short white hairs on the upper surface and hoary-tomentose on the lower surface, about half-grown when the flowers open from the middle to the end of May and then thin, roughened above by short white hairs and sparingly villose below, and at maturity thin but firm in texture, yellow-green, smooth, lustrous and glabrous on the upper surface, paler and nearly glabrous on the lower surface, 3–4 cm. long and 1.3–1.5 cm. wide, with stout yellow midribs, and thin primary veins extending obliquely towards the end of the leaf; petioles slender, narrow-wing-margined to below the middle, tomentose while young, becoming nearly glabrous, 5–6 mm. in length; leaves on vigorous shoots rather thicker, more coarsely serrate, occasionally slightly lobed, 4–5 cm. long and 2.5–3 cm. wide. Flowers 1.2 cm. in diameter, on long slender slightly villose pedicels, in narrow 4–7-, mostly 4- or 5-, flowered corymbs, the long lower peduncle from the axil of the upper leaf; calyx-tube narrowly obconic, covered with short matted pale hairs, the lobes slender, acuminate, finely glandular-serrate, pubescent on the outer, densely villose on the inner surface, reflexed after anthesis; stamens 20; anthers pale yellow; styles 5. Fruit ripening early in October, on long slender slightly hairy drooping pedicels, in few-fruited clusters, subglobose, orange-red, lustrous, 7–9 mm. in diameter; calyx little enlarged, with a wide deep cavity pointed in the bottom, and long spreading and appressed often deciduous lobes; flesh thin, yellow-green, dry and hard; nutlets 5, gradually narrowed and acute at the ends, rounded and slightly grooved on the back, 5–5.5 mm. long, and about 3 mm. wide.

A tree 5 or 6 m. high, with a tall trunk sometimes 6–8 cm. in diameter, covered with dark red-brown bark broken into small closely appressed scales, large branches spreading below and ascending above and forming a broad rather open round-topped symmetrical head, and slender nearly straight branchlets orange-green and covered with pale hairs when they first appear, becoming dull chestnut-red, puberulous and marked by pale lenticels in their first season and reddish brown the following year, and armed with slender straight or slightly curved purple shining spines 4–6 cm. long.

Tops of dry limestone hills, Pacific, Franklin County, *C. S. Sargent*, (No. 6 type) October 1, 1901, *J. H. Kellogg*, May 1, 1902, April 16, 1905; Allenton, St. Louis County, *G. W. Letterman*, May 1883; near St. Louis (without locality), *H. Eggert*, 1886.

The following specimens without floral notes and without fruit probably belong to this species.

Williamsville, Wayne County, *B. F. Bush*, (No 1470) April 29, 1902; Bismarck, St. François County, *J. B. S. Norton*,

April 27, 1902; Doe River to Bismarck, St. François County, *William Trelease* (No. 1270), April 30, 1901; Eureka Springs, Arkansas, *William Trelease*, April 19, 1901.

6. **Crataegus sucida,** n. sp.

Leaves obovate, acute or rounded and short-pointed at the apex, gradually narrowed to the cuneate entire base, finely doubly serrate above, with straight glandular teeth, and slightly divided above the middle into short acute lobes; deeply tinged with red when they unfold; about half-grown when the flowers open at the end of April and then thin, dark yellow-green and slightly roughened above by short white hairs, and paler and hairy on the midribs and veins below, and at maturity subcoriaceous, dark yellow-green, smooth, glabrous and very lustrous on the upper surface, pale and glabrous on the lower surface, 5–6 cm. long and 3.5–4 cm. wide, with stout midribs, and thin primary veins extending very obliquely to the points of the lobes; petioles slender, slightly wing-margined at the apex, covered at first with matted pale hairs, becoming glabrous, often rose color in the autumn, 1–1.5 cm. in length. Flowers 1.5–1.8 cm in diameter, on long slender pubescent pedicels, in wide lax mostly 8–10-flowered corymbs, the long lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, clothed with long appressed white hairs, the lobes slender, acuminate, minutely glandular-serrate, glabrous on the outer, villose on the inner surface, reflexed after anthesis; stamens 15–20; anthers pale yellow; styles 3–5. Fruit ripening at the end of August, on long drooping stems, in few-fruited clusters, subglobose, bright red, 2–2.5 cm. in diameter; calyx little enlarged, with a broad deep cavity, and small spreading appressed persistent lobes; flesh thick, yellow, soft and edible, nutlets 3–5, gradually narrowed and acute at the ends, rounded and slightly grooved or ridged on the back, with a narrow ridge, 4.5–5 mm. long, and 3.5–4 mm. wide.

A tree 7–8 m. high, with slender nearly straight branchlets covered with matted pale hairs when they first appear, becoming chestnut-brown and puberulous in their first season and light red-brown the following year, and armed with very numerous straight or slightly curved purplish ultimately ashy gray spines 4–8 cm. long.

Near Monteer, Shannon County, *B. F. Bush* (No. 13 A type), May 1, 1902, Oct.1, 1905, (No. 13) May 1, 1902, May 15 and Oct.3, 1905, also (Nos. 1449, 1478, 1492, the last with hoary-tomentose pedicels and more hairy leaves).

7. **Crataegus macropoda,** n. sp.

Leaves rhombic to obovate, acute or acuminate at the apex, gradually narrowed to the concave-cuneate entire base, finely often doubly serrate

above, with straight or incurved glandular teeth, and usually very slightly divided above the middle into 2 or 3 pairs of small acute lobes; deeply tinged with red and coated with long white hairs when they unfold, nearly fully grown when the flowers open the end of April and then thin, dark yellow-green and covered above by soft white appressed hairs and villose on the midribs and veins below, and at maturity thin but firm in texture, yellow-green, glabrous, smooth and lustrous on the upper surface, pale and nearly glabrous on the lower surface, 3–4.5 cm. long and 2.5–3 cm. wide, with prominent midribs, and 3 or 4 pairs of thin primary veins extending obliquely to the points of the lobes and deeply impressed on the upper side of the leaf; turning deep orange-red late in the autumn before falling; petioles stout, narrow-wing-margined to below the middle, villose while young, becoming glabrous, 8–10 mm. in length. Flowers 1.8–2 cm. in diameter, on long slender villose pedicels, in narrow crowded mostly 8–10-flowered corymbs, the long lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, thickly covered with appressed white hairs, the lobes narrow, acuminate and rose-colored at the apex, sparingly serrate, with slender glandular teeth, glabrous on the outer, villose on the inner surface, reflexed after anthesis; stamens 15; anthers pale yellow; styles 3–5, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening the end of October, on very slender drooping pedicels, in usually 4- or 5-fruited clusters, subglobose to short-oblong, full and rounded at the ends, crimson, lustrous, marked by large pale dots, 8–10 mm. in diameter; calyx prominent, with a broad deep cavity wide and tomentose in the bottom, and small spreading and appressed lobes; flesh thin, yellow, dry and hard; nutlets 3–5, gradually narrowed and acute at the ends, slightly ridged on the back, with a narrow low ridge, about 5 mm. long, and 3.5–4 mm. wide.

A small tree, with slender slightly zigzag branchlets dark orange-green and covered with matted pale hairs when they first appear, becoming light chestnut-red, verrucose and marked by pale lenticels in their first season and dull gray-brown the following year, and armed with numerous very slender nearly straight purplish shining spines 4–6 cm. long.

Low moist ground, Olympia Park, Webb City, Jasper County, *E. J. Palmer*,(No. 8 A type) October 13 and 20, 1901, April 29, 1902, *E. J. Palmer* and *C. S. Sargent*, (No. 8) October 2, 1901, *E. J. Palmer*, Oct. 13, 1901; Prosperity Junction near Webb City, *E. J. Palmer*, (No. 8 C) April 29, 1902, (No. 8 D) April 29, 1906; Baker's Branch, three miles south of Webb City, *E. J. Palmer* (Nos. 8 E & 8 F) March 31, 1907; Neck City, Jasper County, *E. J. Palmer*, (No. 3, with

15 stamens), March 31, 1901, August 17, 1902, (Nos. 3 B, 3 C & 3 D) March 31, 1907.

8. CRATAEGUS INCAEDUA Sargent, Trees and Shrubs, ii. 3, t. 102 (1907).

Borders of small streams, Monteer, Shannon County, *B. F. Bush* (No. 9 B type), May and October 1905, also (Nos. 501, 510 & 9).

9. **Crataegus hertiflora,** n. sp.

Leaves broadly obovate to oval, acuminate or acute at the apex, gradually narrowed to the concave-cuneate entire base, coarsely often doubly serrate above, with straight glandular teeth, and sometimes slightly divided above the middle into 2 or 3 pairs of small acute lobes; more than half-grown when the flowers open the middle of April and then thin, yellow-green and slightly roughened above by short hairs and below scabrate and villose along the midribs and veins, and at maturity thin but firm in texture, dull dark yellow-green and smooth above, paler yellow-green and slightly villose below on the stout prominent midribs and primary veins, 4–6 cm. long and 3–3.5 cm. wide; petioles stout, wing-margined to the middle, densely villose, 1.5–1.8 cm. in length. Flowers 1.6–1.8 cm. in diameter, on long slender pedicels coated with matted white hairs, in mostly 5–7-flowered hairy corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, hairy like the pedicels, the lobes slender, acuminate, glandular-serrate, villose; stamens 10–15; anthers yellow; styles 4 or 5. Fruit ripening and falling late in September or early in October, on slender slightly villose pedicels, in few-fruited clusters, subglobose, sometimes rather broader than high, crimson, more or less blotched with green, marked by large pale lenticels, 1.5–1.6 cm. in diameter; calyx little enlarged, with a broad deep cavity, and small spreading lobes; flesh thin, pale yellow, sweet and edible; nutlets 4 or 5, gradually narrowed and rounded at the apex, thinner and rounded at the base, ridged on the back, with a broad low slightly grooved ridge, 5.5–6 mm. long and 4–5 mm. wide.

A tree 6–7 m. high, with a trunk sometimes 1.5 dm. in diameter, covered with dark scaly bark broken into short thick plates, stout ascending and spreading light gray branches forming a wide open irregular head, and slender zigzag branchlets light green marked by large pale lenticels and thickly covered with matted pale hairs when they first appear, becoming light chestnut-brown, lustrous and glabrous in their first season and pale reddish brown the following year, and armed with numerous slender

straight or slightly curved dark gray spines 2.5–3 cm. long.

Swan, Taney County, *B. F. Bush*, (No. 8 type) April 20 and October 6, 1907, (No. 8 A) April 21, 1907.

10. CRATAEGUS LETTERMANI Sargent, Bot. Gazette, xxxi. 220 (1901); Silva N. Am. xiii. 79, t. 657; Manual, 397, f. 317.

Near Allenton, St. Louis County.

11. **Crataegus secta,** n. sp.

Leaves oblong-obovate, acute or acuminate, gradually narrowed to the concave-cuneate base, finely doubly serrate often to below the middle, with straight glandular teeth, and deeply divided toward the apex into 4 or 5 pairs of narrow acuminate lobes; when they unfold coated with pale hairs more abundant on the upper surface than on the lower surface, about one-third grown when the flowers open the middle of April and then thin, yellow-green, roughened above by short white hairs and villose below, and at maturity thin, scabrate and dull blue-green on the upper surface, pale bluish green and villose on the lower surface especially on the slender yellow midribs, and 4 or 5 pairs of thin prominent primary veins extending very obliquely to the points of the lobes, 5–6 cm. long and 4–4.5 cm. wide; petioles slender, narrowly wing-margined to the middle, covered while young with long white only partly deciduous hairs, 1–1.2 cm. in length; stipules lanceolate to linear-obovate, more or less falcate, glandular-serrate, fading rose color, often persistent until the flowers open. Flowers 1.8–2 cm. in diameter, on long slender drooping villose pedicels, in compact mostly 5–8-flowered hairy corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, thickly coated with long white hairs, the lobes slender, acuminate, coarsely glandular-serrate, glabrous on the outer, villose on the inner surface, reflexed after anthesis; stamens 5–8; anthers pale yellow; styles 3–5, surrounded at the base by a narrow ring of pale hairs. Fruit ripening in September, on elongated drooping hairy pedicels, in few-fruited clusters, subglobose, crimson, lustrous, marked by many small pale dots, 1–1.2 cm. in diameter; calyx little enlarged, with a deep narrow cavity pointed in the bottom, and small spreading and appressed lobes villose on the upper side; flesh thin, dry and hard; nutlets 3–5, narrowed and rounded, or when 5 acute at the ends, ridged on the back, with a broad high slightly grooved ridge, 5.5–6 mm. long, and about 5 mm. wide.

A tree 4 or 5 m. high, with a short stem covered with dark scaly bark, stout spreading branches armed like the trunk with numerous long dull gray spines, and slender nearly straight branchlets light red-brown and coated for 2 or 3

years with long white hairs, finally becoming ashy gray and glabrous, and armed with slender nearly straight purple spines 5–6 cm. long.

Low moist soil near Carthage, Jasper County, *E. J. Palmer* and *C. S. Sargent*, (No. 6 type) May 11, 1902, *E. J. Palmer*, July 13, 1902, April 14, 1903; hills, Prosperity Junction, near Webb City, Jasper County, *E. J. Palmer* (No. 13) April 28 and September 28, 1902, April 13, 1903, (No. 13 A) April 27, 1902.

VIRIDES.

Leaves usually thin, usually acute or acuminate at the ends or rarely broad at the base; petioles slender, elongated, mostly eglandular; flowers in usually many-flowered corymbs; stamens 15–20; anthers yellow (color unknown in No. 8); fruit subglobose to short-oblong or obovate.

Fruit not exceeding 7 mm. in diameter.
Corymbs many-flowered.
Fruit scarlet.
Fruit subglobose; leaves ovate to oblong-obovate; bark smooth, gray or pale orange color. 1. *C. viridis.*
Fruit obovate; leaves oval to rhombic; bark dark and scaly. 2. *C. larga.*
Fruit orange or orange-red, subglobose.
Leaves lanceolate. 3. *C. lanceolata.*
Leaves ovate. 4. *C. ovata.*
Corymbs 5–8-flowered; fruit orange-red; leaves oval to obovate. 5. *C. furcata.*

Fruit 1–1.8 cm. long.
Fruit pruinose.
Leaves lanceolate to oblong-obovate, acuminate, coriaceous, dark green, very lustrous; fruit dull brick-red, up to 1.8 cm. in length. 6. *C. nitida.*
Leaves obovate, rounded and short-pointed or acute at the apex, thin, yellow-green; fruit crimson, 1–1.2 cm. in diameter. 7. *C. ludoviciensis.*
Fruit not pruinose.
Fruit subglobose to short-oblong.
Leaves obovate to oval or rhombic, narrowed at the base; fruit crimson; corymbs glabrous. 8. *C. mitis.*
Leaves ovate, rounded or truncate at the broad base, fruit dark red; corymbs slightly villose. 9. *C. atrorubens.*
Fruit obovate; leaves ovate to oval; corymbs slightly villose; fruit orange-red. 10. *C. Dawsoniana.*

1. CRATAEGUS VIRIDIS Linnaeus, Spec. 476 (1753).—Sargent, Silva N. Am. iv. 109, t. 187; Manual, 401, f. 320.—Beadle in Small, Fl. Southeastern U. S. 540.—Britton, Manual, 520.

Crataegus arborescens, Elliott, Sk. i. 550 (1821).—Torrey & Gray, Fl. N. Am. i. 466.—Nuttall, Silva, ii. 10, t. 45.—Chapman, Fl. 127.

Des Pères River bottoms, Carondelet, St. Louis County, *J. H. Kellogg;* Fenton, *J. H. Kellogg* (Nos. 1 & 2), April 29, 1905, (No. 5) Oct. 1907; Gasconade, Gasconade County, *J. H. Kellogg*, (No. 1) May 7, 1905; Osage, Cole County, *J. H. Kellogg*, (No. 2) May 6, 1905, (No. 8) October 1, 1907; Campbell, Dunklin County, *B. F. Bush* (No. 296); Butler County (without locality) *B. F. Bush* (No. 3); Moark, (No. 3 A) *B. F. Bush;* Mississippi River bottoms, Illinois, very common; also south through Arkansas to eastern Texas and through the Gulf States to Florida and Virginia.

2. **Crataegus larga,** n. sp.

Glabrous with the exception of the hairs on the young leaves and their petioles. Leaves ovate to oval, rhombic or rarely obovate, acuminate at the ends, and finely serrate, with incurved glandular teeth; nearly fully grown when the flowers open in the first week of May and then thin, yellow-green, lustrous and slightly hairy on the midribs above and paler and furnished with small tufts of axillary hairs below, and at maturity thin but firm in texture, dark yellow-green,smooth, lustrous and glabrous above, paler yellow-green and still slightly hairy below, 4–6 cm. long and 2–3.5 cm. wide, with prominent yellow midribs, and thin primary veins; petioles slender, slightly wing-margined at the apex, sparingly villose while young, soon becoming glabrous, often rose color in the autumn, 1–1.5 cm. in length; leaves on vigorous shoots ovate, acuminate, rounded or abruptly cuneate at the base, coarsely serrate, sometimes deeply lobed by narrow sinuses, often 7–9 cm. long and 6–7 cm. wide, with stout winged petioles and foliaceous lunate coarsely serrate persistent stipules. Flowers 1.2 cm. in diameter, on long slender pedicels, in wide lax mostly 15–20-flowered crowded corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from the base, short, wide, acuminate and glandular at the apex, entire or occasionally minutely dentate, reflexed after anthesis; stamens 20; anthers pale yellow; styles 3–5, usually 5. Fruit ripening the middle of October, on long slender drooping pedicels, in wide many-fruited clusters, obovate, full and rounded at the apex, gradually narrowed at the base, scarlet, lustrous, marked by small pale dots, 6–7 mm. long and 7–8 mm. in diameter; calyx little enlarged, with a deep narrow cavity, and small

spreading and reflexed lobes; flesh thin, yellow, dry and mealy; nutlets 3–5, gradually narrowed and rounded at the apex, acute at the base, about 3 mm. long, and 2.5 mm. wide.

A tree 8 or 9 m. high, with a trunk often 2.5 dm. in diameter, covered with dark scaly bark, small ascending branches forming a narrow oblong head, and stout nearly straight branchlets dark orange-green and marked by pale lenticels when they first appear, becoming bright chestnut-brown and lustrous in their first season and dull red-brown the following year, and armed with slender straight chestnut-brown spines 1.5–4 cm. long, and persistent, very numerous and compound on old stems.

Roadside on the banks of Cahokia Creek, north of Cahokia, Illinois, *J. H. Kellogg*, (X type), May 7, 1903, August 2, 1902, October 18, 1905.

3. Crataegus lanceolata Sargent, Trees and Shrubs, ii. 65, t. 130 (1908).

River des Pères bottoms, Carondelet, St. Louis County, *J. H. Kellogg* (No. 4 type), May and November 1902, May 1905, (No. 1) May and October 1903 and 1906.

4. Crataegus ovata Sargent, Manual, 402, f. 321 (1905).

River des Pères bottoms, Carondelet, St. Louis County, *J. H. Kellogg.*

5. **Crataegus furcata, n. sp.**

Glabrous with the exception of the hairs on the young leaves and petioles and on the calyx-lobes. Leaves oval to slightly obovate, acute and short-pointed, acuminate or rounded at the apex, gradually narrowed to the concave-cuneate entire base, and coarsely serrate above the middle, with straight or incurved glandular teeth; when they unfold deeply tinged with red and covered above by short white hairs and glabrous below with the exception of small axillary tufts and of a few hairs along the midribs, nearly fully grown when the flowers open in the first week of May and then thin, yellow-green, smooth, lustrous and glabrous above, and at maturity thin but firm in texture, dark yellow-green, glabrous and very lustrous on the upper surface, paler and still sparingly villose on the lower surface on the prominent rose-colored midribs and slender obscure primary veins, 4–5 cm. long and 1.5–2.5 cm. wide; petioles slender, slightly wing-margined at the apex, villose on the upper side while young, becoming glabrous, rose-colored in the autumn, 6–12 mm. in length; leaves on vigorous shoots thicker, ovate, acuminate and long-pointed at

the apex, cuneate at the base, coarsely serrate, frequently 3-lobed by broad sinuses, the terminal lobe divided into 2 or 3 short lateral lobes, often 5–6 cm. long and 4–5 cm. wide, with stout winged petioles, and linear glandular caducous stipules. Flowers 1.2–1.4 cm. in diameter, on long slender pedicels, in mostly 5–8-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from the base, short, broad, acuminate and glandular at the apex, entire or minutely dentate, glabrous on the outer, very sparingly villose on the inner surface, reflexed after anthesis; stamens 20; anthers pale yellow; styles 3 or 4. Fruit ripening late in October, on slender drooping pedicels, in few-fruited clusters, subglobose to short-oblong, orange-red, lustrous, 7–8 mm. in diameter; calyx little enlarged, with a wide deep cavity, and small erect and incurved often deciduous lobes; flesh thin, yellow, dry and hard; nutlets 3 or 4, gradually narrowed and rounded at the ends, slightly ridged or rounded and grooved on the back, 4.5–5 mm. long, and about 3 mm. wide.

A shrub 5–7 m. high, with numerous large spreading stems covered with dark orange-colored smooth bark, small spreading branches forming a very broad round-topped rather open head, and slender zigzag branchlets light orange-green more or less tinged with red when they first appear, becoming light chestnut-brown, lustrous and marked by pale lenticels in their first season and dull gray-brown the following year, and armed with numerous slender straight or slightly curved light chestnut-brown spines 2.5–6 cm. long.

Rocky hillsides, and near small streams in rich soil, Prosperity Junction near Webb City, Jasper County, *E. J. Palmer* (No. 6 type) May 19 and October 27, 1901, May 8, 1902, (No. 7, with 15–20 stamens, also No. 550) *B. F. Bush*, May 19, 1901, *E. J. Palmer* and *C. S. Sargent*, October 2, 1901, *E. J. Palmer*, October 7, 1901, May 8, 1902, (No. 7 A) *E. J. Palmer*, May 4 and Oct. 20, 1902, (No. 7 D) *E. J. Palmer*, April 14, 1907; Neck City, Jasper County, *E. J. Palmer*, (No. 7) April 28, 1907.

6. Crataegus nitida Sargent, Bot. Gazette, xxxi. 231 (1901); Silva N. Am. xiii. 179, t. 703; Manual, 406, f. 325.—Britton, Manual, 520.

Crataegus viridis Sargent, Silva N. Am. iv. 109 (in part) (not Linnaeus) (1892).

Crataegus viridis var. *nitida* Britton and Brown, Ill. Fl. ii. 242 (1897).

Mississippi River bottoms, East St. Louis, Illinois, common.

7. CRATAEGUS LUDOVICIENSIS Sargent, Trees and Shrubs, ii. 5, t. 103 (1907).

Des Pères River bottoms, Carondelet, St. Louis County, *J. H. Kellogg*, (No. 7) 1902-1905.

8. CRATAEGUS MITIS Sargent, Manual, 407, f. 326 (1905).

Mississippi River bottoms at Cahokia, below East St. Louis, Illinois, *J. H. Kellogg*.

9. CRATAEGUS ATRORUBENS Ashe, Jour. Elisha Mitchell Sci. Soc. xvi. pt. ii. 78 (1900).—Sargent, Silva N. Am. xiii. 181, t. 704; Manual, 408, f. 327.

Mississippi River bottoms, East St. Louis, Illinois.

10. **Crataegus Dawsoniana,** n. sp.

Leaves ovate to oval, acuminate, gradually or abruptly narrowed and concave-cuneate at the entire base, sharply often doubly serrate above, with straight glandular teeth, and occasionally slightly 3-lobed at the apex; about half-grown when the flowers open late in May or early in June and then very thin, yellow-green, sparingly hairy on the midribs above and villose on the midribs and primary veins and in their axils below, and at maturity thin, dark yellow-green and glabrous above, paler and still slightly hairy below on the stout rose-colored midribs and slender primary veins, 4–6 cm. long and 3–4 cm. wide; petioles slender, slightly wing-margined at the apex, villose during the season, 1–1.5 cm. in length; stipules linear-obovate, falcate, minutely glandular-dentate, green, deciduous; leaves on vigorous shoots ovate, rounded or abruptly cuneate at the broad base, more coarsely serrate, laterally lobed, with broad acute lobes, often 7–8 cm. long and 6–7 cm. wide, with foliaceous lunate coarsely glandular-serrate persistent stipules. Flowers 1.4–1.5 cm. in diameter, on long slender slightly hairy pedicels, in wide mostly 10–15-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, covered with matted pale hairs, the lobes gradually narrowed from the base, acute, finely glandular-serrate, glabrous on the outer, villose on the inner surface, reflexed after anthesis; stamens 20; anthers pale yellow; styles 4 or 5. Fruit ripening in October and remaining on the branches during the winter, on long slender nearly glabrous red pedicels, in many-fruited drooping clusters, obovate, full and rounded at the apex, gradually narrowed at the base, orange-red, lustrous, marked by occasional dark dots, 1–1.2 cm. long and 8–10 mm. in diameter; calyx little enlarged, with a wide shallow cavity, and small spreading lobes dark red on the upper side below the middle; flesh thick, yellow, dry and mealy; nutlets 4 or 5, acute at the base, narrowed and rounded at the apex, rounded and only slightly grooved on the back, 4.5–5 mm. long, and 3–3.5 mm. wide.

A small tree, with a trunk covered with pale scaly bark, spreading branches forming a wide irregular head, and slender branchlets orange-green more or less tinged with red and slightly hairy when they first appear, becoming dark chestnut-brown, lustrous and marked by pale lenticels in their first season and dull red-brown the following year, and unarmed or armed with occasional short stout spines.

This plant was raised at the Arnold Arboretum from seeds collected in 1883 by Mr. G. W. Letterman at East St. Louis, Illinois. The trees from which this seed was gathered have not been seen in recent years and they have probably been destroyed in the rapid spread of the city over the Mississippi bottoms.

I take much pleasure in associating with this handsome and distinct tree the name of Mr. Jackson Dawson, the Superintendent of the Arnold Arboretum, the skilful and successful propagator who has raised more forms of Crataegus than any man of his time.

PRUINOSAE.

Leaves generally broad at the base; petioles long, usually slender; flowers large; fruit subglobose to short-oblong, ovate or obovate, often broader than high, frequently angled, red or green, more or less pruinose, 1–2.2 cm. in diameter, late-ripening, the mature calyx-lobes often raised on a short tube; nutlets 3–5.

Stamens 20.

Anthers rose color or pink.

Mature leaves smooth on the upper surface (sometimes scabrate in No. 1); fruit broader than high.

Leaves blue-green.

Flowers on stout pedicels; anthers rose color; fruit crimson; leaves villose below on the midribs and veins early in the season. 1. *C. bracteata.*

Flowers on slender pedicels; anthers pink; fruit green faintly tinged with red; leaves nearly glabrous early in the season. 2. *C. rubicundula.*

Leaves yellow-green.

Leaves setose above early in the season, thin; anthers bright red; fruit deep orange-red, slightly or not at all pruinose. 3. *C. platycarpa.*

Leaves smooth above early in the season, thick; anthers pale pink; fruit pink, very pruinose. 4. *C. calliantha.*

Mature leaves scabrate on the upper surface.
Flowers on glabrous pedicels, in glabrous corymbs; calyx-lobes villose on the inner surface; anthers faintly tinged with rose color; fruit broader than high.
5. *C. decorata.*
Flowers on villose pedicels, in slightly hairy corymbs; calyx-lobes glabrous; anthers rose color; fruit short-oblong. 6. *C. aspera.*
Anthers yellow or white; mature leaves smooth above.
Leaves blue-green.
Leaves very thin.
Leaves broadly ovate, mostly rounded at the base; fruit ovate, angled below the middle; calyx-cavity broad and shallow. 7. *C. magnifolia.*
Leaves ovate, cuneate or rarely rounded at the base; fruit short-oblong to slightly obovate, not angled; calyx-cavity broad and deep.
8. *C. patrum.*
Leaves thick; fruit subglobose; calyx-cavity broad and deep. 9. *C. aperta.*
Leaves yellow-green.
Leaves and pedicels glabrous; fruit broader than high, truncate at the base, 5-angled, up to 2.2 cm. in diameter, scarlet.
10. *C. callicarpa.*
Leaves hairy above early in the season; pedicels slightly villose; fruit subglobose, not angled, not more than 1.4 cm. in diameter, dull green tinged with red.
11. *C. locuples.*
Color of anthers unknown; leaves blue-green, glabrous; fruit subglobose to short-oblong, sometimes angled, green, finally becoming red. 12. *C. Mackenzii.*
Stamens 10.
Anthers rose color or pink.
Leaves dark blue-green; anthers rose color.
13. *C. disjuncta.*
Leaves light yellow-green; anthers pale pink.
14. *C. rigida.*
Anthers yellow
Leaves ovate, blue-green; pedicels and calyx-lobes glabrous; fruit subglobose, green, finally becoming dull red. 15. *C. brachypoda.*
Leaves rhombic to ovate, dark yellow-green; pedicels and inner surface of the calyx-lobes villose; fruit subglobose to short-oblong, on hairy pedicels, green, becoming orange-yellow. 16. *C. sicca.*

1. **Crataegus bracteata,** n. sp.

Glabrous with the exception of the hairs on the young leaves and calyx-lobes. Leaves ovate, acuminate, rounded, abruptly concave-cuneate or cordate at the entire base, finely doubly serrate above, with straight or incurved glandular teeth, and slightly divided into 3 or 4 pairs of small acuminate spreading lobes; more than half-grown when the flowers open the first of May and then thin, yellow-green, slightly roughened above by short white hairs, and villose below at the base of the midribs and primary veins, and at maturity thin, dull blue-green and scabrate or smooth on the upper surface, pale bluish green and glabrous on the lower surface, 6–8 cm. long and 3–6 cm. wide, with slender midribs, and thin primary veins arching obliquely to the points of the lobes; petioles slender, slightly wing-margined at the apex, occasionally glandular, often rose color in the autumn, 2.5–5 cm. in length; leaves on vigorous shoots subcoriaceous, cordate or rounded at the base, 6–7 cm. long and 5.5–6.5 cm. wide. Flowers 2–2.2 cm. in diameter, on long stout pedicels, in compact mostly 5- or 6-flowered corymbs, with large foliaceous glandular bracts and bractlets persistent until the flowers open, the lower peduncles from the axils of upper leaves; calyx-tube broadly obconic, the lobes gradually narrowed from wide bases, acuminate, minutely glandular-serrate, glabrous on the outer, slightly pubescent on the inner surface, reflexed after anthesis; stamens 20; anthers rose color; styles 3–5, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening early in November, on long drooping or spreading pedicels, in usually 1- or 2-fruited clusters, subglobose but often rather broader than high, crimson, slightly pruinose, becoming lustrous, marked by small pale dots, 1.2–1.4 cm. in diameter; calyx prominent, with a broad deep cavity, and small spreading or incurved persistent lobes; flesh thick, yellow-green, dry and hard; nutlets 3–5, narrowed and acute at the ends, or when 3 rounded at the base, irregularly ridged on the back, with a narrow ridge, 5–5.5 cm. long, and 4–4.5 mm. wide.

A shrub 2–3 m. high, with numerous erect stems, and slender zigzag branchlets light yellow-green when they first appear, becoming light chestnut-red, lustrous and marked by small pale lenticels in their first season and orange color and lustrous in their second year, and armed with very numerous stout or slightly curved purple shining spines 5–6.5 cm. long.

Jasper County; bottom-lands of Baker's Branch, two miles south of Webb City, *E. J. Palmer* and *C. S. Sargent* (No. 16 type), Oct. 2, 1901, *E. J. Palmer*, November 3, 1901, and May 4, 1904, bottoms of Turkey Creek, *E. J. Palmer*, (No. 16A) Nov. 3, 1901, May 4, 1902, Upper Turkey Creek (Nos. 16 B and 16 C), November 1901.

2. CRATAEGUS RUBICUNDULA Sargent, Trees and Shrubs, ii. 7, t. 104 (1907).

River des Pères bottoms, Carondelet, St. Louis County, *H. Eggert*, 1886, *J. H. Kellogg* (No. 9 type) 1902, 1903.

3. **Crataegus platycarpa,** n. sp.

Leaves ovate, acuminate, abruptly concave-cuneate or rounded at the entire base, sharply doubly serrate above, with straight glandular teeth, and divided into 4 or 5 pairs of small acuminate spreading lobes; about half-grown when the flowers open at the end of April and then thin, yellow-green and setose above and pale and furnished below with small axillary tufts of white hairs, and at maturity thin, dark yellow-green, glabrous, smooth and lustrous on the upper surface, paler and nearly glabrous on the lower surface, 5–5.5 cm. long and 4–4.5 cm. wide, with slender midribs, and thin primary veins arching obliquely to the points of the lobes; petioles slender, narrow-wing-margined at the apex, slightly villose while young, becoming glabrous, sparingly glandular, with usually deciduous glands, 1.5–3 cm. in length; leaves on vigorous shoots usually rounded or truncate at the broad base, more coarsely serrate and more deeply lobed, 6–7 cm. long, and nearly as wide. Flowers 2–2.2 cm. in diameter, on short glabrous pedicels, in small compact usually 4- or 5-flowered corymbs, with linear-obovate to linear glandular-serrate bracts and bractlets fading rose color and often persistent until the flowers open, the short lowest peduncle from the axil of the upper leaf; calyx-tube broadly obconic, glabrous, the lobes wide, acuminate, entire or occasionally minutely dentate, glabrous, reflexed after anthesis; stamens 20; anthers large, bright red; styles 3–5, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening the middle of October, on short stems, in 1–3-fruited clusters, depressed-globose, broader than high, somewhat angled at the base, deep orange-red, 1.1–3 cm. in diameter; calyx prominent, with a broad shallow cavity, and small spreading or incurved persistent lobes; flesh thick, yellow, becoming soft and succulent; nutlets 3–5, acute at the base, broader and rounded at the apex, irregularly ridged on the back, with a high narrow ridge, about 6 mm. long, and 5 mm. wide.

A tree 5–7 m. high, with a trunk 5–12 cm. in diameter, small branches, and slender nearly straight glabrous branchlets light green tinged with red when they first appear, becoming light chestnut-brown, lustrous, and marked by small pale lenticels in their first season and ashy gray the following year, and armed with numerous stout slightly curved purple shining spines 3.5–5 cm. long.

Dry ridges between swamps, Moark, on the boundary between Butler County and Arkansas, *B. F. Bush* (No. 4 type), May 1 and Oct. 15, 1905.

4. **Crataegus calliantha,** n. sp.

Glabrous with the exception of the hairs on the young leaves. Leaves ovate, acuminate, rounded or subcordate at the broad entire base, sharply often doubly serrate above, with straight glandular teeth, and slightly divided usually only above the middle into 3 or 4 pairs of small acuminate spreading lobes; about half-grown when the flowers open in the last week of April and then thin, dark yellow-green, smooth, lustrous and slightly hairy on the upper side of the midribs and pale bluish green below, and at maturity thick, yellow-green, smooth and lustrous on the upper surface, paler on the lower surface, 4–5 cm. long and 3–3.5 cm. wide, with slender midribs, and thin primary veins arching obliquely to the points of the lobes; petioles slender, slightly wing-margined at the apex, sparingly villose on the upper side while young, soon glabrous, occasionally glandular, with minute mostly deciduous glands, 2–2.5 cm. in length; leaves on vigorous shoots broadly ovate, rounded or cordate at the base, often 6–7 cm. long and 6–6.5 cm. wide, with stout rose-colored midribs and more prominent veins. Flowers 2.2–2.5 cm. in diameter, on slender pedicels, in compact mostly 5–7-flowered corymbs, with conspicuous oblong-obovate to linear glandular dark rose-colored bracts and bractlets persistent until the flowers open, the long lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from the base, long, broad, acuminate, coarsely glandular-serrate near the middle, reflexed after anthesis; stamens 20; anthers pale pink; styles 2–4, surrounded at the base by a broad ring of pale tomentum. Fruit broader than high, angled, pink, very pruinose, about 1 cm. in diameter; calyx prominent, with a short tube, a broad deep cavity wide and tomentose in the bottom, and small spreading lobes; flesh thin, pale yellow, dry and mealy; nutlets usually 4, gradually narrowed and rounded at the ends, ridged on the back, with a broad low slightly grooved ridge, 6–7.5 mm. long, and 4–4.5 mm. wide.

A shrub 1–1.5 dm. high, with small erect stems covered with dark rough bark, and slender nearly straight branchlets dark orange-green when they first appear, becoming light orange-brown very lustrous and marked by numerous small pale lenticels in their first season and dark chestnut-brown and lustrous the following year, and armed with numerous stout nearly straight dark chestnut-brown shining spines 3–4 cm. long.

Limestone hills, Allenton, St. Louis County, and Pacific, Franklin County, common; Sweeney's Hill, Allenton, *J. H. Kellogg* (no number, flowers), April 25, 1905; Pacific, *J. H. Kellogg,* (No. 100, fruit), September 29, 1907.

5. **Crataegus decorata,** n. sp.

Leaves obovate, acuminate, rounded or abruptly cuneate at the broad entire base, doubly serrate above, with long straight glandular teeth, and divided into 4 or 5 pairs of short broad spreading lateral lobes; nearly fully grown when the flowers open about the 20th of April and then thin, yellow-green and setose above and pale and villose along the midribs and veins below, and at maturity thin, light yellow-green and scabrate on the upper surface, pale bluish green and villose, with long white hairs on the stout rose-colored midribs and slender primary veins on the lower surface, 4–5 cm. long, and 3–4 cm. wide; petioles slender, slightly wing-margined at the apex, sparingly villose, rose-colored at the base late in the season, 1.8–2 cm. in length. Flowers 1.8–2 cm. in diameter, on long slender glabrous pedicels, in lax mostly 6–10-flowered glabrous corymbs, the lower peduncles from the axils of upper leaves; calyx-tube broadly obconic, bright green, glabrous, the lobes broad, short, acuminate and glandular at the apex, finely glandular-serrate, glabrous on the outer, sparingly villose on the inner surface, reflexed after anthesis; stamens 20; anthers faintly tinged with rose color; styles 3 or 4, surrounded at the base by a narrow ring of pale tomentum. Fruit on short slender drooping pedicels, in few-fruited clusters, broader than high, slightly 5-angled, dull red, marked by large dark dots, 1.3–1.5 cm. wide, 1–1.2 cm. high; calyx little enlarged, with a short tube, a wide deep cavity, and small spreading lobes; flesh thick, pink, dry and hard; nutlets 3 or 4, narrowed and rounded at the ends, irregularly ridged on the back, with a broad narrow ridge, 4.5–5 mm. long, and 4 mm. wide.

A much-branched shrub 3–4 m. high, with numerous small stems, and slender nearly straight glabrous branchlets dark green tinged with red when they first appear, becoming dull light chestnut-brown in their first season and gray tinged with red the following year, and armed with slender straight or slightly curved chestnut-brown spines 5–6 cm. long.

Rocky hillsides, Swan, Taney County, *B. F. Bush* (No. 18 type) April 21 and October 7, 1907, (No. 18 C) April 24, 1907.

6. Crataegus aspera Sargent, Trees and Shrubs, ii. 67, t. 131 (1908).

Near Webb City, Jasper County, *E. J. Palmer*, (No. 15 type) November 3, 1901, May and October, 1902.

7. Crataegus magnifolia Sargent, Trees and Shrubs, ii. 69, t. 132 (1908).

Near Webb City, Jasper County, *E. J. Palmer*, (No. 26 type) April 30 and September 25, 1905.

8. Crataegus patrum, n. sp.

Glabrous with the exception of the hairs on the young leaves. Leaves ovate, acuminate, usually cuneate or rarely rounded at the frequently unsymmetrical base, coarsely often doubly serrate above, with straight glandular teeth, and slightly divided into 5 or 6 pairs of small acuminate spreading lobes; more than half-grown when the flowers open about the 1st of May and then thin, yellow-green, smooth, lustrous and furnished with occasional white hairs on the midribs above and pale bluish green below, and at maturity very thin, dark blue-green, smooth and lustrous on the upper surface, paler bluish green on the lower surface, 5–6 cm. long and 4–4.5 cm. wide, with stout yellow midribs, and thin primary veins arching obliquely to the points of the lobes; petioles slender, slightly wing-margined at the apex, glandular, with minute often persistent glands, 2.5–3 cm. in length; leaves on vigorous shoots thicker, ovate, rounded, subcordate, or abruptly cuneate at the wide base, more coarsely serrate, more deeply lobed, 6–8 cm. long and nearly as broad, with long glandular petioles. Flowers 2–2.2 cm. in diameter, on slender glabrous pedicels, in compact mostly 6–10-flowered corymbs, with small glandular rose-colored bracts and bractlets mostly deciduous before the flowers open, the long lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from the base, short, wide, minutely glandular-dentate usually only near the middle, reflexed after anthesis; stamens 20; anthers pale yellow; styles 3–5. Fruit ripening the middle of October, on stout spreading or drooping pedicels, in few-fruited clusters, short-oblong or slightly obovate, full and rounded at the ends, dull green, pruinose, marked by large dark dots; calyx little enlarged, with a short tube, a deep wide cavity, and spreading and sometimes slightly incurved lobes, their tips often deciduous from the ripe fruit; flesh thick, green, dry and hard; nutlets usually 3 or 4, gradually narrowed at the ends, acute at the apex, rounded at the base, slightly ridged on the back, about 6 mm. long, and 4–4.5 mm. wide.

A tree sometimes 7 or 8 m. high, with a tall trunk 7–10 cm. in diameter, covered with dark bark broken into closely appressed scales, small spreading erect branches forming an open irregular head, and slender nearly straight or zigzag branchlets dark orange-green more or less tinged with red and marked by pale lenticels when they first appear, becoming light chestnut-brown and very lustrous in their first season and dull red-brown the following year, and armed with slender straight or curved purplish shining spines 2–3.5 cm. long.

River des Pères bottoms, Carondelet, St. Louis County, *H. Eggert*, May 9, 1887, *C. S. Sargent*, September 26, 1900, *J. H. Kellogg* (No. 9 A type), May 7, 1903, May 3 and October

15, 1905, September 28, 1907, (No. 9 B) May 7, 1903, October 15, 1905.

9. **Crataegus aperta,** n. sp.

Glabrous. Leaves broadly ovate, acuminate, rounded, truncate or rarely abruptly cuneate at the wide base, finely doubly serrate, with straight glandular teeth, and divided into 3 or 4 pairs of small acuminate lobes; deep bronze color when they unfold, more than half-grown when the flowers open about the 20th of April, and then thin, light yellow-green above and pale bluish green below, and at maturity thin, blue-green, smooth and lustrous on the upper surface, lighter bluish green on the lower surface, 4–7 cm. long and 4.5–5 cm. wide, with stout midribs, and slender primary veins. Flowers 1.8–2 cm. in diameter, on long slender pedicels, in small compact mostly 5–7-flowered corymbs, with conspicuous obovate to linear glandular bracts and bractlets fading rose color and often persistent until after the flowers open, the lower peduncles from the axils of upper leaves; calyx-tube broadly obconic, the lobes gradually narrowed from wide bases, short, minutely glandular-dentate near the middle, reflexed after anthesis; stamens 20; anthers light yellow; styles 3–5. Fruit ripening in October, on stout spreading pedicels, in few-fruited clusters, subglobose, dull green slightly tinged with red, about 1 cm. in diameter; calyx prominent, without a tube, with a broad deep cavity tomentose in the bottom, and small spreading lobes; flesh green, hard and dry; nutlets 3–5, rounded at the base, narrowed and rounded or acute at the apex, irregularly ridged on the back, with a high narrow ridge 6–6.5 mm. long, and 4–4.5 mm. wide.

A narrow shrub sometimes 5 m. high, with small stems, erect branches, and slender nearly straight branchlets dark green tinged with red when they first appear, becoming dark chestnut-brown in their first season and dull grayish brown the following year, and armed with slender straight or slightly curved purple ultimately ashy gray spines 3–5 cm. long.

Rocky Hills, Swan, Taney County, *B. F. Bush,* (No. 19 A type) April 22 and October 7, 1907, (Nos. 19, 19 B, 19 C) April 22 and 23, 1907.

10. **Crataegus callicarpa,** n. sp.

Glabrous with the exception of the hairs on the young leaves and calyx-lobes. Leaves ovate, acute, cordate at the base, very coarsely often doubly serrate, with long straight glandular teeth, and slightly divided into 3 or 4 pairs of short broad acuminate lateral lobes; not more than a quarter grown when the flowers open late in April and then very thin, yellow-green and slightly hairy above and on the midribs below, and at maturity thin, glabrous, crumpled, dark yellow-green and very lustrous on the upper surface, pale yellow-green on the lower surface, 5.5–6.5 cm. long and

5–6 cm. wide, with stout midribs, and 3 or 4 pairs of prominent primary veins connected by conspicuous cross veinlets; petioles stout, slightly wing-margined at the apex, sparingly glandular, with minute deciduous glands, 2.5–3 cm. in length; leaves on vigorous shoots thicker, with shorter glandular petioles rose-colored towards the base. Flowers about 2.5 cm. in diameter, on short stout pedicels, in small compact mostly 5–10-flowered corymbs, with lanceolate to linear-obovate glandular bracts and bractlets usually persistent until the flowers open, the lower peduncles from the axils of upper leaves; calyx-tube broadly obconic, the lobes separated by wide sinuses, short, broad, acuminate, coarsely glandular-serrate, sparingly villose on the inner surface, reflexed after anthesis; stamens 20; anthers white; styles 5, surrounded at the base by a broad ring of pale tomentum. Fruit ripening early in October, on short stout spreading pedicels, in 2- or 3-fruited clusters, broader than high, distinctly 5-angled, rounded at the wide apex, truncate at the base, with a deep depression at the insertion of the pedicel, scarlet, pruinose, becoming very lustrous, marked by numerous large pale dots, 1.8–2.2 cm. broad and 1.6–1.8 cm. high; calyx without a tube, with a broad deep cavity narrow and tomentose in the bottom, and deciduous lobes; flesh thin, light yellow slightly tinged with red, dry and mealy, with a pleasant flavor; remaining on the ground through the winter without becoming soft; nutlets 5, thin, acute at the apex, rounded at the base, rounded and slightly grooved or ridged on the back, with a low grooved ridge, 5.5–6 mm. long, and 5–5.5 mm. wide.

A tree 6–7 m. high, with a tall trunk 1.2–1.5 dm. in diameter, large ascending and spreading branches, and stout nearly straight branchlets dark orange-green when they first appear, becoming light chestnut-brown, very lustrous and marked by small pale lenticels in their first season and dull red-brown the following year, and armed with occasional straight or slightly curved stout purplish spines 3.5–5 cm. long.

Hillsides, Shrewsbury, St. Louis County, *C. W. Fullgraf* and *J. H. Kellogg*, April 26 and September 30, 1907.

The fruit of this species is the largest and handsomest I have seen on any plant in this group.

11. **Crataegus locuples,** n. sp.

Leaves ovate, acuminate, rounded or subcordate at the broad base, sharply often doubly serrate, with long straight glandular teeth, and divided into 4 or 5 pairs of broad acuminate lateral lobes; deeply tinged with red when they unfold, about one-third grown when the flowers open the middle of April and then thin, yellow-green, roughened above by short white hairs and villose on the midribs and veins below, and at maturity thin, dark yellow-green, glabrous and lustrous on the upper surface, lighter-colored and glabrous on the lower surface with the exception of

occasional hairs on the stout midribs, and prominent primary veins connected by conspicuous cross veinlets, 6–8 cm. long and 5–6.5 cm. wide; petioles stout, slightly wing-margined at the apex, densely villose while young, becoming glabrous, rose color toward the base in the autumn, 2.5-3 cm. in length; leaves on vigorous shoots rather thicker and often 12–14 cm. long and 10–12 cm. wide. Flowers 2–2.2 cm. in diameter, on short slender slightly hairy pedicels, in compact mostly 7–10-flowered corymbs, with large oblong-obovate to linear-obovate glandular bracts and bractlets mostly persistent until the flowers open, the elongated lower peduncles from the axils of upper leaves; calyx-tube broadly obconic, the lobes gradually narrowed from wide bases, short, acute, laciniately glandular-serrate, glabrous on the outer, villose on the inner surface, reflexed after anthesis; stamens 20; anthers white; styles 3–5, surrounded at the base by a broad ring of pale tomentum. Fruit ripening early in October, on short drooping red glabrous pedicels, in few-fruited clusters, subglobose, dull green tinged with red, 1.2–1.4 cm. in diameter; calyx prominent, with a short tube, a broad shallow cavity tomentose in the bottom, and deciduous lobes; flesh thin, dry and hard; nutlets 3–5, usually 5, narrowed and rounded at the ends, irregularly ridged on the back, with a slightly grooved ridge, 7–7.5 mm. long, and 4–4.5 mm. wide.

A tree 7–8 m. high, with a tall trunk 1–1.5 dm. in diameter, covered with dark scaly bark, large ascending and spreading pale gray branches forming a narrow oblong irregular head, and slender slightly zigzag glabrous branchlets pale green when they first appear, becoming light chestnut-brown, very lustrous and marked by small pale lenticels in their first season and lighter-colored the following year, and armed with occasional stout nearly straight purple shining spines 2–3.5 cm. long.

Wooded hillsides, near Barrett's Station, St. Louis County, *J. H. Kellogg*, (No. 9 A type) May 9, 1902, May 4, 1905, April 14, and September 28, 1907.

12. Crataegus Mackenzii Sargent in Mackenzie and Bush, Man. Fl. Jackson County, Missouri, 108 (1902).

Glabrous with the exception of the hairs on the young leaves. Leaves ovate, acute, rounded, abruptly cuneate or truncate at the broad base, sharply often doubly serrate, with straight glandular teeth, and slightly divided into 3 or 4 pairs of narrow acuminate lateral lobes; deeply tinged with red when they unfold, more than half-grown when the flowers open about the 1st of May and then thin, yellow-green and slightly hairy above and pale and glabrous below, and at maturity thin, dark blue-green, smooth and lustrous on the upper surface, pale bluish green on the lower surface, 5–6 cm. long and 4.5–5 cm. wide, with slender yellow midribs, and thin primary veins; turning scarlet in the autumn; petioles slender, slightly

wing-margined and occasionally glandular near the apex, often rose-colored late in the season, 1.5–2 cm. in length; leaves on vigorous shoots thicker, mostly cordate at the base, more coarsely serrate, more deeply lobed, and from 5–6 cm. long and wide. Flowers on long stout pedicels, in narrow mostly 5- or 6-flowered corymbs, with oblong-obovate to linear glandular rose-colored bracts and bractlets often persistent until the petals fall, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from broad bases, short, acuminate, entire or minutely glandular-serrate, reflexed after anthesis; stamens 20; color of the anthers unknown; styles 4 or 5. Fruit ripening in October, on stout elongated erect or spreading pedicels, in few-fruited clusters, subglobose to short-oblong or often rather broader than high, somewhat angled, green, finally becoming lurid red, pruinose, 1–1.2 cm. in diameter; calyx prominent, with a short tube, a wide deep cavity broad and tomentose in the bottom, and spreading lobes, their tips often deciduous from the ripe fruit; flesh thin, dry and hard; nutlets 4 or 5, gradually narrowed and acute at the apex, rounded at the base, rounded and grooved or slightly ridged on the back, about 5 mm. long, and 4 mm. wide.

A shrub 2–7 m. high, with small intricately branched stems, and stout slightly zigzag branchlets dark orange-green when they first appear, becoming light chestnut-brown, very lustrous and marked by small pale lenticels in their first season and dull gray-brown the following year, and armed with numerous slender nearly straight purple shining spines 4–7 cm. long.

Rocky barrens, Jackson County; widely distributed but not common.

13. Crataegus disjuncta Sargent, Trees and Shrubs, i. 109, t. 55 (1903).

Monteer, Shannon County, *B. F. Bush* (Nos. 253, 345, 1488 and 1495), 1899, 1902.

14. **Crataegus rigida,** n. sp.

Glabrous with the exception of a few hairs on the upper side of the young leaves. Leaves oblong-obovate, acuminate, rounded or abruptly cuneate at the broad base, finely often doubly serrate above, with straight glandular teeth, and slightly divided into 4 or 5 pairs of small spreading acuminate lobes; about half-grown when the flowers open from the 20th to the 25th of April and then very thin, more or less tinged with red, smooth and slightly hairy on the midribs above and pale below, and at maturity thin, light yellow-green, smooth and lustrous on the upper surface, 4–5 cm. long and 3–4 cm. wide, with slender midribs, and thin obscure primary

veins; petioles slender, slightly wing-margined at the apex, rose color while young, glandular, with often persistent glands, 1.5–2 cm. in length. Flowers 1.8–2 cm. in diameter, on slender pedicels, in compact mostly 5–7-flowered corymbs, with linear-obovate to linear glandular rose-colored bracts and bractlets often persistent until the flowers open, the long lower peduncles from the axils of the upper leaves; calyx-tube narrowly obconic, the lobes gradually narrowed from wide bases, short, broad, acuminate, entire or minutely glandular-dentate, reflexed after anthesis; stamens 10; anthers pale pink; styles 2–5. Fruit ripening early in October, on slender drooping pedicels, in few usually 1- or 2-fruited clusters, subglobose, often broader than high, distinctly angled, green faintly flushed with rose color, pruinose, 1–1.2 cm. in diameter; calyx little enlarged, without a tube, with a broad shallow cavity, and small erect and spreading or incurved persistent green lobes; flesh thin, green, dry and hard; nutlets usually 3 or 4, narrowed and rounded at the base, more acute at the apex, ridged on the back, with a narrow grooved ridge, about 5 mm. long, and 4 mm. wide.

A shrub 3–4 m. high, with stems 5–8 cm. in diameter, covered with dark scaly bark, stout spreading and erect rigid branches, and slender zigzag branchlets dark orange-green when they first appear, becoming dull dark olive-green and marked by pale lenticels in their first season and dull reddish brown the following year, and armed with slender straight purplish shining spines 2–3 cm. long.

Oak woods on limestone hills, Pacific, Franklin County *J. H. Kellogg*, (no number) April 24 and September 31, 1907.

15. **Crataegus brachypoda,** n. sp.

Glabrous with the exception of the hairs on the upper surface of the young leaves and petioles. Leaves ovate, acuminate, rounded or abruptly cuneate at the broad entire or glandular base, coarsely doubly serrate above, with straight glandular teeth, and slightly divided into 5 or 6 pairs of short broad lateral lobes; about one-third grown when the flowers open early in May and then thin, yellow-green and slightly roughened above by short white hairs, and glabrous below, and at maturity thin, blue-green, smooth and lustrous on the upper surface, pale bluish green on the lower surface, 5.5–6 cm. long and 4–5 cm. wide, with thick midribs, and prominent primary veins arching obliquely to the points of the lobes; petioles slender, slightly wing-margined at the apex, soon becoming glabrous, glandular while young, with minute often stipitate glands, 2–3 cm. in length; leaves on vigorous shoots rounded or cordate at the broad base, more coarsely serrate, often 8–9 cm. long and 6–7 cm. wide, with foliaceous lunate glandular-serrate stipules. Flowers 2 cm. in diameter, on very short pedicels, in compact mostly 5- or 6-flowered corymbs, the lowest peduncle from the axil of an upper leaf; calyx-tube narrowly obconic, the

lobes gradually narrowed from broad bases, wide, short, acuminate, entire or occasionally glandular-dentate, reflexed after anthesis; stamens 10; anthers pale yellow; styles 3–5, surrounded at the base by a broad ring of pale hairs. Fruit ripening early in October and soon falling, on short pedicels, in few-fruited clusters, subglobose, green more or less tinged with red, finally becoming dull red, 1–1.2 cm. in diameter; calyx little enlarged, with a small shallow cavity, and spreading appressed often deciduous lobes dark red on the upper side below the middle; flesh thin, green, dry and hard; nutlets 3–5, narrowed and acute at the ends, or when 3, rounded at the ends, ridged on the back, with a broad grooved ridge, or when 5, rounded and slightly grooved on the back, 5.5–6 mm. long, and 3.5–4 mm. wide.

A tree 4–7 m. high, with a trunk 8–14 cm. in diameter, covered with dark rough scaly bark, spreading and ascending branches, and stout slightly zigzag branchlets dark orange-green tinged with red when they first appear, becoming dark chestnut-brown, lustrous, and marked by pale lenticels in their first season and dull reddish brown the following year, and armed with numerous slender nearly straight purple shining spines 2.5–5 cm. long.

Gravelly banks of streams near Grandin, Carter County, *B. F. Bush* (No. 4 type), May 6, and Oct. 10, 1905, (No. 4 A) May 7 and Oct. 12, 1905, also (No. 282), May 4, 1901; Pleasant Grove, Ripley County, *B. F. Bush*, (Nos. 386, 387, 388) May 7, 1901.

16. **Crataegus sicca**, n. sp.

Leaves rhombic to ovate, acuminate, gradually narrowed to the cuneate entire base, finely doubly serrate above, with incurved glandular teeth, and slightly divided above the middle into 3 or 4 pairs of small acute lobes; deeply tinged with red when they first appear, about one-half grown when the flowers open from the 20th to the end of April and then very thin, roughened above by short white hairs and slightly hairy on the midribs below, and at maturity thin but firm in texture, dark yellow-green, glabrous, smooth and lustrous on the upper surface, pale on the lower surface, 3.5–4.5 cm. long and 2.5–3 cm. wide, with thin prominent sparingly hairy midribs and veins; petioles slender, slightly wing-margined at the apex, villose while young, becoming nearly glabrous, often dark rose color in the autumn, 8–12 mm. in length. Flowers 1.8–2 cm. in diameter, on short slender slightly villose pedicels, in small compact mostly 5–8-flowered corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, glabrous, the lobes short, slender, acuminate, glandular-serrate usually only above the middle, often light red, glabrous on the outer, villose on the inner surface, reflexed after anthesis; stamens 10; anthers

white; styles 3–5. Fruit ripening early in October, on short slender hairy spreading pedicels, in few-fruited clusters, subglobose to short-oblong, green, becoming light orange-yellow, marked by large pale dots, about 1 cm. in diameter; calyx little enlarged, with a short tube, a narrow deep cavity pointed at the base, and small spreading usually persistent green lobes; flesh thick, green, dry and mealy; nutlets 3–5, gradually narrowed and acute at the ends, ridged on the back, with a broad high grooved ridge, 6–6.5 mm. long, and about 5 mm. wide.

A shrub 1–2 m. high, with small intricately branched stems, and very slender nearly straight glabrous branchlets light green when they first appear, becoming light chestnut-brown, lustrous and marked by pale lenticels in their first season and dull gray-brown the following year, and unarmed or armed with slender straight purple spines 3–3.5 cm. long.

Dry limestone hills, Pacific, Franklin County, *C. S. Sargent*, (No. 1) October 1, 1901, *J. H. Kellogg*, (No. D type) April 24 and 29, 1907.

MOLLES.

Leaves broad, tomentose or pubescent; petioles long; flowers 1.8–2.5 cm. in diameter, in usually many-flowered tomentose or villose corymbs; stamens 20, or 15 in No. 4; fruit subglobose, short-oblong or obovate, red or rarely yellow, often more or less pubescent, 1–2.5 cm. in diameter; flesh thick, often edible; nutlets generally 5, thin, narrowed at the ends, only obscurely grooved or ridged on the back.

Anthers yellow or white.
Leaves mostly broad and rounded at the base.
Fruit subglobose to short-oblong.
Leaves thick to subcoriaceous, broadly ovate, yellow-green; flowers in many-flowered hoary-tomentose corymbs; fruit ripening in August and September. 1. *C. mollis.*
Leaves thin, ovate, blue-green; flowers in 8–12-flowered slightly villose corymbs; fruit ripening in October. 2. *C. declivitatis.*
Fruit oval, crimson, ripening in October; leaves ovate, thin.
Fruit 1.8–2 cm. long; nutlets 7.5–8 mm. in length; leaves scabrate above. 3. *C. macrophylla.*
Fruit not more than 1.5 cm. long; nutlets 5–5.5 mm. in length; leaves smooth above; stamens 15. 4. *C. lasiantha.*
Fruit obovate; leaves ovate, scabrate above.
Flowers on short pedicels, in wide 15–20-flowered corymbs; fruit ripening in October. 5. *C. umbrosa.*

Flowers on long pedicels, in compact 10–15-flowered corymbs; fruit ripening early in August.
6. *C. lanigera.*

Leaves narrow at the base, ovate to oval, yellow-green.
Fruit subglobose, crimson, ripening late in September; leaves scabrate above. 7. *C. Treleasei.*
Fruit obovate, scarlet, ripening in August; leaves glabrous above. 8. *C. dumetosa.*

Anthers rose color.
Leaves broad at the base.
Leaves thin, smooth, yellow-green; fruit subglobose to ovate, bright yellow, ripening at the end of September.
9. *C. Kelloggii.*
Leaves subcoriaceous, scabrous, dark blue-green; fruit subglobose to short-oblong, dark crimson, ripening at the end of October. 10. *C. lanuginosa.*
Leaves narrow at the base, thin, yellow, scabrate; fruit obovate, light cherry-red, ripening in October.
11. *C. dispessa.*

1. Crataegus mollis Scheele, Linnaea, xxi. 569 (1848).—Sargent, Silva N. Am. xiii. 83, t. 659; Bot. Gazette, xxxv. 379; Manual, 423, f. 341; Rep. Geolog. Surv. Michigan, 1906, 343.

This species, widely and generally distributed usually on bottom-lands from Ohio to Nebraska, is apparently common in the neighborhood of St. Louis and in Jackson County, and possibly reaches Jasper County. Some of the trees, however, which have been referred to this species, vary greatly in the thickness of their leaves and in the time when the fruit ripens, and I have not yet sufficient material and information to make it possible to form a clear idea of the limits of variation and of the range of this tree in Missouri.

2. **Crataegus declivitatis**, n. sp.

Leaves ovate, acuminate, rounded or abruptly cuneate at the broad base, coarsely often doubly serrate, with straight glandular teeth, and slightly divided into 5 or 6 pairs of acuminate spreading lobes; slightly tinged with red when they unfold, not more than a quarter grown when the flowers open from the middle to the 20th of April and then very thin, covered above by short white hairs and villose on the midribs and primary veins below, and at maturity thin, dark bluish green, glabrous and tomentose on the upper surface, pale blue-green on the lower surface, 6–8 cm. long and 5–6 cm. wide, with thin sparingly villose midribs and primary

veins; petioles slender, slightly wing-margined at the apex, coated while young with matted pale hairs, becoming nearly glabrous, 2–3.5 cm. in length; stipules linear-obovate, falcate, acute, glandular-serrate, fading brown, often persistent until the flowers open; leaves on vigorous shoots very coarsely serrate, more deeply lobed, and often 10–11 cm. long and 9–10 cm. wide, with foliaceous lunate coarsely serrate deciduous stipules. Flowers 1.7–1.8 cm. in diameter, on long slender slightly hairy pedicels, in compact mostly 8–12-flowered corymbs, with linear-obovate to linear glandular bracts and bractlets often persistent until the flowers open; calyx-tube broadly obconic, glabrous, the lobes abruptly narrowed from the base, short, wide, acuminate, glandular-serrate usually only above the middle, glabrous on the outer, slightly villose on the inner surface, reflexed after anthesis; stamens 20; anthers light yellow; styles 5, surrounded at the base by a broad ring of pale tomentum. Fruit ripening in October, on spreading nearly glabrous pedicels, in few-fruited clusters, subglobose to short-oblong, green tinged with dull red, very hard (September 28, 1907), slightly pubescent at the ends when fully grown, becoming glabrous, 1.2–1.3 cm. in diameter; calyx prominent, with a short tube, a broad deep cavity pointed in the bottom, and slightly spreading and erect often deciduous lobes hairy on the upper side; flesh green, dry and hard; nutlets 5, gradually narrowed and rounded at the base, broad and rounded at the apex, rounded and slightly grooved on the back, 7–7.5 mm. long, and about 4 mm. wide.

A shrub 3–5 m. high, with stems 7.5–10 cm. in diameter, covered with dark scaly bark, spreading branches forming a round-topped head, and slender slightly zigzag branchlets dark green and sparingly villose when they first appear, becoming light chestnut-brown, lustrous, glabrous and marked by dark lenticels in their first season and dull gray-brown the following year, and armed with stout straight or slightly curved chestnut-brown spines 1.5–2 cm. long.

Steep bluffs of the Mississippi River, South St. Louis, St. Louis County, *J. H. Kellogg*, (no number) May 5, 1902, September 9, 1906, April 19 and September 28, 1907.

3. **Crataegus macrophylla**, n. sp.

Leaves ovate, acute or acuminate, rounded, truncate, abruptly cuneate or slightly cordate at the broad base, coarsely often doubly serrate, with straight glandular teeth, and slightly divided into 5 or 6 pairs of small acuminate lateral lobes; about half-grown when the flowers open in the last week of April and then very thin, dark yellow-green and strigose above and covered below with pale hairs most abundant on the midribs and veins, and at maturity thin, yellow-green, lustrous and scabrate on the upper surface and villose on the slender midribs and primary veins on the

lower surface, 8–9 cm. long and 6.5–7 cm. wide; petioles stout, hoary-tomentose early in the season, becoming villose, 2–3 cm. in length; stipules linear-lanceolate, falcate, glandular-serrate, hairy, deciduous; leaves on vigorous shoots cordate at the base, more coarsely serrate and often 9–10 cm. long and 8.5–9 cm. wide, with glandular petioles 3–4 cm. long, and large foliaceous lunate coarsely serrate persistent stipules. Flowers 2–2.2 cm. in diameter, on short stout hoary-tomentose pedicels, in small compact mostly 8–12-flowered corymbs, with oblong-obovate to linear often falcate tomentose bracts and bractlets persistent until the flowers open, the short lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, densely coated with matted pale hairs, the lobes long, narrow, acuminate, irregularly glandular-dentate, glabrous on the outer, villose on the inner surface, reflexed after anthesis; stamens 20; anthers cream color; styles 5. Fruit ripening in October, on stout villose pedicels, in few-fruited drooping clusters, oval, gradually narrowed and rounded at the apex, more abruptly narrowed at the base, crimson, lustrous, marked by large pale dots, pubescent at the ends, 1.8–2 cm. long and 1.5–1.6 cm. in diameter; calyx with a short tomentose tube, and a deep narrow cavity tomentose in the bottom and nearly closed by the small erect lobes; flesh thin, yellow, dry and hard; nutlets 5, gradually narrowed and rounded at the ends, rounded and slightly grooved on the back, 7.5–8 mm. long, and 5.5–6 mm. wide.

A tree 7–8 m. high, with a trunk covered with dark rough bark, spreading branches, and stout nearly straight branchlets coated with hoary tomentum when they first appear, light orange-brown, lustrous, marked by pale lenticels and very slightly hairy at the end of their first season, becoming light gray the following year, and armed with straight slender purplish spines 3–4 cm. long.

River des Pères bottoms, Carondelet, St. Louis County, *J. H. Kellogg*, (No. 6 type) April 27 and October 1, 1902.

4. Crataegus lasiantha, n. sp.

Leaves ovate, acute at the apex, rounded or truncate at the base, coarsely doubly serrate, with straight glandular teeth, and slightly divided into 6 or 7 pairs of small acute lateral lobes; nearly half-grown when the flowers open the first of May and then very thin, dark bluish green, slightly roughened by short white hairs and villose on the midribs above and villose especially on the midribs and veins below, and at maturity thin but firm in texture, dark yellow-green, smooth and lustrous on the upper surface, pale and still hairy on the lower surface on the stout yellow midribs, and thin primary veins extending obliquely to the points of the lobes, 8–10 cm. long and 5–8 cm. wide; petioles stout, slightly wing-margined at the apex, densely hoary tomentose early in the season, becoming pubescent, 2.5–4

cm. in length; leaves on vigorous shoots more coarsely serrate and more deeply lobed, often 10–12 cm. long and 7–9 cm. wide. Flowers about 1.8 cm. in diameter, on stout hoary-tomentose pedicels, in narrow compact tomentose mostly 5- or 6-flowered corymbs, with lanceolate to linear acuminate glandular green bracts and bractlets often persistent until after the petals fall, the long lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, hoary-tomentose, the lobes long, slender, acuminate, laciniately glandular-serrate, densely villose, reflexed after anthesis; stamens 15; anthers pale yellow; styles 5. Fruit ripening in October, on long stout slightly hairy pedicels, in drooping few-fruited clusters, oval, crimson, lustrous, marked by small pale dots, densely villose when fully grown, becoming nearly glabrous late in the autumn, about 1.5 cm. long and 1.2 cm. in diameter; calyx prominent, with a short tube, a very deep narrow cavity, and spreading or incurved lobes dark red and nearly glabrous on the upper side; flesh thick, yellow, dry and hard; nutlets 5, narrowed and rounded at the apex, acute at the base, rounded and sometimes obscurely ridged on the back, only 5–5.5 mm. long, and 4 mm. wide.

A tree 7–8 m. high, with stout slightly zigzag branchlets thickly coated with hoary tomentum when they first appear, becoming light orange-brown and marked by pale lenticels in their first season, and light red-brown and lustrous the following year, and armed with slender slightly curved purplish spines 5.5–6 cm. long.

Low moist soil near streams, Webb City, Jasper County, *E. J. Palmer* and *C. S. Sargent*, (No. 11 D type) October 2, 1901, *E. J. Palmer*, July 16, 1901, May 4, 1902, (No. 11) *E. J. Palmer*, April 12, 1903, (No. 11 B) *E. J. Palmer*, September 8, 1901, (No. 11 C) *E. J. Palmer*, November 1, 1901, (No. 20) May 18, 1902, April 12, 1902.

This species is exceptional in this group in the small size of the nutlets and in the unusual development of the hypostyle which sometimes covers a large part of their inner faces.

5. **Crataegus umbrosa,** n. sp.

Leaves ovate, acuminate, rounded, truncate or abruptly cuneate at the broad base, coarsely often doubly serrate, and usually divided into 4 or 5 pairs of wide acuminate spreading lobes; about one-third grown when the flowers open from the middle to the 20th of April and then thin, dark yellow-green and covered above with soft white hairs and hoary-tomentose below, and at maturity thin, yellow-green and scabrate on the upper surface and tomentose on the lower surface especially on the slender midribs and primary veins, 7–8 cm. long and 5–5.5 cm. wide; petioles slender,

slightly wing-margined at the apex, densely coated with hoary tomentum, 2–3 cm. in length; leaves on vigorous shoots ovate, abruptly or sharply cuneate at the base, more coarsely serrate, more deeply lobed and often 10–12 cm. long and 8–10 cm. wide. Flowers about 2 cm. in diameter, on short stout tomentose pedicels, in wide mostly 15–20-flowered tomentose corymbs, with oblong to linear often falcate green bracts and bractlets persistent until the flowers open, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, densely tomentose, the lobes gradually narrowed from the base, long, broad, acuminate, coarsely glandular-serrate, tomentose below and glabrous above on the outer surface, slightly villose on the inner surface, reflexed after anthesis; stamens 20; anthers white; styles 5, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening in October, on slender hairy red pedicels, in drooping many-fruited clusters, obovate to subglobose, scarlet, marked by pale dots, pubescent at the ends, about 1 cm. in diameter; calyx little enlarged, with a deep narrow cavity and small spreading and appressed persistent lobes pubescent on the upper surface; flesh thin, dry and hard; nutlets 5, thin, gradually narrowed and acute at the ends, rounded and slightly grooved on the back, 7.5–8 mm. long, and 5.5–6 mm. wide.

A tree sometimes 10 m. high, with a trunk 1–2 dm. in diameter, covered with light gray bark broken into small close persistent scales, large erect and spreading branches forming a wide open irregular head, and slender slightly zigzag branchlets thickly coated with hoary tomentum when they first appear, remaining green and tomentose through their first season, becoming light olive-green, lustrous and marked by numerous dark lenticels in their second season and light gray the following year, and armed with many stout or slender straight or slightly curved purplish shining spines 3–4 cm. long.

River des Pères bottoms, Carondelet, St. Louis County, *J. H. Kellogg,* (No. 10 type) October 8, 1901, April 26 and October 8, 1903, April 17, 1905.

6. **Crataegus lanigera,** n. sp.

Leaves ovate, acuminate, abruptly concave-cuneate or rounded at the entire base, coarsely often doubly serrate above, with straight glandular teeth, and slightly divided into 3 or 4 pairs of small acute lateral lobes; less than one-quarter grown when the flowers open the middle of April and then thin, yellow-green and covered above with soft white hairs and hoary-tomentose below, and at maturity conspicuously reticulate-venulose, thin, yellow-green, lustrous and scabrate on the upper surface, paler, yellow-green and still tomentose on the lower surface, 6–7 cm. long and 5–5.5 cm. wide, with stout tomentose midribs, and slender primary veins extend-

ing to the points of the lobes; petioles slender, slightly wing-margined at the apex, tomentose, sparingly glandular while young, 1.5–2.5 cm. in length; leaves on vigorous shoots ovate, acuminate, rounded or subcordate at the base, more coarsely serrate, only slightly lobed and often 9–10 cm. wide, with stout petioles often rose color in the autumn, and foliaceous lunate glandular-serrate persistent stipules. Flowers 1.8–2 cm. in diameter, on long stout hairy-tomentose pedicels, in compact hoary-tomentose mostly 10–15-flowered corymbs, with oblong-obovate to linear glandular bracts and bractlets often persistent until the flowers open, the long lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, tomentose, the lobes short, broad, acuminate, laciniately glandular-serrate, pubescent on the outer, glabrous on the inner surface, reflexed after anthesis; stamens 20; anthers white; styles 5, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening early in August, on stout drooping red hairy pedicels, in few-fruited clusters, obovate, full and rounded at the apex, gradually narrowed to the slender base, crimson, lustrous, pubescent at the ends, 1.8–2 cm. long and 1–1.1 cm. in diameter; calyx little enlarged, with a deep narrow cavity tomentose in the bottom, and small spreading appressed lobes; flesh thin, yellow, rather juicy; nutlets 5, thin, acute at the base, rounded at the apex, only slightly ridged on the back, about 7 mm. long, and 4.5 mm. wide.

A tree 7–8 m. high, with a stem sometimes a decimeter in diameter, covered with dark rough bark, large spreading branches forming a wide irregular head, and stout slightly zigzag branchlets coated when they first appear with long matted white hairs, becoming light chestnut-brown, sparingly villose and marked by small pale lenticels in their first season and glabrous and pale red the following year, and armed with slender straight or slightly curved purple shining spines 3–4.5 cm. long.

Roadside on the bank of Cahokia Creek north of Cahokia, Illinois, *J. H. Kellogg* (No. 51 A type), August 2, 1902, April 17, 1907, north of Cahokia (no number), August 2, 1903, April 17, 1907, (No. 52) August 2, 1902, April 27, 1903, April 17, 1907; East St. Louis, *J. H. Kellogg,* No. E, (with larger leaves, narrower fruit and much smaller spines), is possibly distinct, August 11, 1902, April 21, 1903.

7. Crataegus Treleasei Sargent, Trees and Shrubs, i. 63, t. 32 (1903); Manual, 427, f. 345.

Banks of small streams, Doe Run to Bismarck, St. François County.

8. **Crataegus dumetosa,** n. sp.

Leaves ovate to oval, acute or acuminate, gradually narrowed and rounded or abruptly cuneate at the entire base, coarsely often doubly serrate above, with straight glandular teeth, and slightly divided usually only above the middle into 3 or 4 pairs of acute lobes; nearly half-grown when the flowers open about the middle of April and then thin, yellow-green and roughened above by short white hairs and hoary tomentose below especially on the midribs and veins, and at maturity thin, yellow-green, smooth and lustrous on the upper surface, pale yellow-green and villose on the lower surface especially on the stout midribs, and slender primary veins arching obliquely to the points of the lobes, 5–6 cm. long and 4–5 cm. wide; petioles slender, hoary-tomentose early in the season, becoming pubescent, 1–2.5 cm. in length; leaves on vigorous shoots more coarsely serrate, more deeply lobed, often 7–8 cm. long and 6–7 cm. wide, with narrow lunate finely glandular-serrate persistent stipules. Flowers 2–2.2 cm. in diameter, on stout hoary-tomentose pedicels, in compact mostly 10–15-flowered corymbs, with linear falcate acuminate villose glandular often persistent bracts and bractlets, the long lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, thickly coated with long matted white hairs, the lobes short, slender, acuminate, glandular-serrate, pubescent on the outer, villose on the inner surface, reflexed after anthesis; stamens 20; anthers pale yellow; styles 5, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening early in August, on short stout slightly hairy spreading pedicels, in few-fruited clusters, obovate, gradually narrowed and rounded at the apex, rather abruptly narrowed and rounded at the base, scarlet, lustrous, slightly pubescent at the ends, marked by small dark dots, 1.2–1.3 cm. long and 1 cm. in diameter; calyx prominent, with a short tube, a wide deep cavity, and spreading and appressed lobes only slightly hairy on the upper side; flesh thin, yellow, dry and hard; nutlets 5, thin, acute at the ends, rounded or sometimes slightly grooved on the back, 6.5–7 mm. long, and about 5 mm. wide.

A shrub 2–3 m. high, with numerous small stems covered with dark slightly scaly bark, slender ascending branches, and stout somewhat zigzag branchlets coated when they first appear with hoary tomentum, becoming light chestnut-brown, glabrous, lustrous, and marked by pale lenticels in their first season and dull reddish brown the following year, and armed with few slender nearly straight purple ultimately gray spines 2–3 cm. long.

Thickets in fertile uplands, Neck City, Jasper County, *E. J. Palmer*, (No. 2 type) August 8, 1902, April 15, 1903, March 31 and October 4, 1907.

9. Crataegus Kelloggii Sargent, Trees and Shrubs, i. 117, t. 59 (1903); Manual, 431, f. 349.

River Des Pères bottoms, Carondelet, St. Louis County.

10. Crataegus lanuginosa Sargent, Trees and Shrubs, i. 113, t. 57 (1903); Manual, 435, f. 353.

Near Webb City, Jasper County, common.

11. Crataegus dispessa Ashe, Jour. Elisha Mitchell Sci. Soc. xix. pt. i. 17 (1903).

Crataegus pyriformis Britton, Bull. N. Y. Bot. Gard. i. 449 (not Jacques, Jour. Soc. Hort. France, iv. 599 [1858]) (1900).—Sargent, Silva N. Am. xiii. 97, t. 666; Manual, 434, f. 352.

Near streams, Monteer, Shannon County.

DILATATAE.

Leaves wide at the base, often broader than long on vigorous shoots; petioles long and slender; flowers large, in compact 5–8-flowered corymbs; stamens 20; anthers rose color; fruit broader than high, slightly angled, crimson, lustrous, 2–2.2 cm. in diameter.

Flowers not more than 1.8 cm. in diameter, on very short often slightly villose pedicels; fruit flattened at the ends; calyx much enlarged on the fruit, with a narrow deep cavity pointed in the bottom, and broad lobes bright red on the upper side; flesh red.

1. *C. coccinioides.*

Flowers up to 2.5 cm. in diameter, on longer glabrous pedicels; fruit rounded at the ends; calyx little enlarged on the fruit, with a very broad shallow cavity wide in the bottom, and narrow lobes not red on the upper side; flesh pale yellow. 2. *C. speciosa.*

1. Crataegus coccinioides Ashe, Jour. Elisha Mitchell Sci. Soc. xvi. pt. ii. 74 (1900).—Sargent, Silva N. Am. xiii. 115, t. 674; Manual, 458, f. 374.

Crataegus Eggerti Britton, Bull. N. Y. Bot. Gard. i. 447 (1900); Manual, 520.

Woods, west of Forest Park, St. Louis, Fenton, and Allenton, St. Louis County; Pacific, Franklin County.

2. Crataegus speciosa Sargent, Trees and Shrubs, i. 65, t. 33 (1903).

Rocky hills, near Webb City, Jasper County; common, *E. J. Palmer* (No. 5 type).

COCCINEAE.

Leaves rhombic to oblong-obovate, cuneate at the base, subcoriaceous, dark green and lustrous above; petioles long; flowers 1.5–1.8 cm. in diameter, in many-flowered hairy corymbs; stamens 20; anthers pale yellow; fruit short-oblong to subglobose, dull red, 1.2–1.4 cm. in diameter; nutlets 2 or 3, rounded at the apex, acute at the base.

1. CRATAEGUS MARGARETTA Ashe, Jour. Elisha Mitchell Sci. Soc. xvi. pt. ii. 72 (1900).—Sargent, Silva N. Am. xiii. 137, t. 685; Manual, 461, f. 377.

Webster and Bertold, St. Louis County; Springfield, Greene County; also in Illinois, Iowa, Michigan, Ontario, and middle Tennessee.

INTRICATAE.

Leaves cuneate at the base; petioles long, usually slender; flowers 1.6–2.5 cm. in diameter, in few-flowered corymbs; fruit subglobose to short-oblong, 1–1.5 cm. long; flesh dry and hard; nutlets 3–5, rounded at the ends, usually conspicuously ridged on the back.

Stamens 10; glabrous with the exception of occasional hairs on the young leaves and calyx-lobes.

Anthers rose color; calyx-lobes glabrous; fruit orange-red; leaves ovate to rhombic.

1. *C. Neo-Bushii.*

Anthers yellow, faintly tinged with rose; calyx-lobes sparingly villose on the inner surface; fruit green slightly flushed with red; leaves ovate to oval. 2. *C. padifolia.*

Stamens 5–10.

Anthers yellow slightly tinged with rose; flowers 1.6–1.8 cm. in diameter, in densely villose corymbs; calyx-lobes villose; fruit orange-yellow, hairy at the ends; leaves blue-green, scabrate.

3. *C. villicarpa.*

Anthers yellow; flowers 2–2.5 cm. in diameter, in glabrous corymbs; calyx-lobes glabrous; fruit green flushed with red, glabrous; leaves yellow-green, smooth.

4. *C. leioclada.*

1. CRATAEGUS NEO-BUSHII Sargent, Trees and Shrubs, ii. 9, t. 105 (1907).

Dry gravelly soil near Monteer, Shannon County, *B. F. Bush,* (Nos. 10 A, 10 B type) May and October 1905.

2. CRATAEGUS PADIFOLIA Sargent, Trees and Shrubs, ii. 75, t. 135 (1908).

Hillsides, Swan, Taney County, *B. F. Bush,* (No. 5 B type) April and September 1907, (also Nos. 5, 5 A, 5 C, 5 D, 5 F, 5 I, 5 J, 5 K, 149 and 152).

3. **Crataegus villicarpa,** n. sp.

Leaves ovate, acuminate, gradually narrowed and concave-cuneate at the entire base, finely doubly serrate above, with straight or incurved glandular teeth, and slightly divided into 3 or 4 pairs of slender acuminate lateral lobes; more than half-grown when the flowers open from the 10th to the middle of May and then dark blue-green and setose above and sparingly villose below along the midribs and veins, and at maturity thin but firm in texture, blue-green and scabrate on the upper surface, scabrate, and slightly villose on the midribs and veins on the lower surface, 5–6 cm. long and 3.5–4.5 cm. wide; petioles slender, narrowly wing-margined to the middle, densely villose early in the season, becoming pubescent or nearly glabrous, glandular, with persistent glands, 2–3 cm. in length; leaves on vigorous shoots broadly ovate, short-pointed at the apex, rounded or subcordate at the base, more coarsely serrate and often 5–6 cm. long and broad. Flowers 1.6–1.8 cm. in diameter, on short slender densely villose pedicels, in small compact mostly 3–5-flowered hairy corymbs, with conspicuous oblong-obovate coarsely glandular-serrate bracts and bractlets mostly persistent until the flowers open; calyx-tube narrowly obconic, thickly covered with long matted white hairs, the lobes long, slender, acuminate, glandular-serrate, nearly glabrous on the outer, villose on the inner surface, reflexed after anthesis; stamens 5–10; anthers pale yellow; styles 3–5, surrounded at the base by a ring of pale tomentum. Fruit short-oblong to subglobose, full and rounded at the ends, orange-yellow sometimes more or less tinged with red, marked by large pale dots, villose at the ends, with long scattered pale hairs, 1–1.2 cm. in diameter; calyx prominent, with a broad shallow cavity wide and tomentose in the bottom, and elongated spreading and appressed persistent lobes ciliate on the margins towards the base and villose on the upper side; flesh thin, yellow, dry and mealy; nutlets 3–5, rounded at the ends or acute at the apex, ridged on the back, with a broad low slightly grooved ridge, 4.5–5 mm. long, and about 4 mm. wide.

A shrub 1–2 m. high, with small pale gray stems, very slender slightly zigzag branchlets light red-brown and covered with long white hairs when they first appear, becoming dull chestnut-brown and pubescent in their first season and gray tinged with red the following year, and armed with numerous slender curved or straight bright red-brown shining spines

pointing toward the base of the branch and 3.5–6 cm. long, and small pale winter-buds.

Rocky hills and barrens, Swan, Taney County, *B. F. Bush*, (No. 2 D type) May 19 and October 7, 1907, (No. 2) May 19, 1905, (Nos. 2 B, 2 C, 2 E, 2 F) May 16, 1907, (No. 366) June 9, 1898, (Nos. 43, 46, 52 and 107) June 18, 1899, (No. 509) September, 1899.

4. **Crataegus leioclada,** n. sp.

Glabrous with the exception of the hairs on the young leaves and calyx-lobes. Leaves ovate to oval, acuminate, gradually or abruptly narrowed and concave-cuneate at the broad base, sharply often doubly serrate, with long straight or incurved glandular teeth, and deeply divided into 4 or 5 pairs of slender acuminate spreading lateral lobes; nearly fully grown when the flowers open the middle of May and then very thin, dark yellow-green, lustrous and sparingly hairy above, with soft white hairs, paler, lustrous and glabrous below, and at maturity thin but firm in texture, yellow-green, lustrous on the upper surface, paler on the lower surface, 5–6 cm. long and 4–4.5 cm. wide, with conspicuous yellow midribs, and thin primary veins extending obliquely to the points of the lobes; petioles slender, slightly wing-margined at the apex, sparingly villose on the upper side while young, soon glabrous, glandular, with numerous minute dark persistent glands, 1.2–1.6 cm. in length. Flowers 2–2.5 cm. in diameter, on long stout pedicels, in mostly 2–4-flowered narrow corymbs, the elongated lowest peduncle from the axil of an upper leaf; calyx-tube broadly obconic, the lobes gradually narrowed from wide bases, long, slender, acuminate, rose-colored and glandular at the apex, glandular-serrate to above the middle, glabrous on the outer, sparingly villose on the inner surface, reflexed after anthesis; stamens 5–10; anthers yellow faintly tinged with rose color; styles 3 or 4. Fruit ripening late in September or early in October, on long drooping pedicels, in 2- or 3-fruited clusters, subglobose to short-oblong, full and rounded at the ends, green more or less flushed with red, 1–1.2 cm. in diameter; calyx little enlarged, with a deep narrow cavity, and elongated spreading and closely appressed or erect and incurved lobes; flesh thin, green and hard; nutlets 2 or 3, rounded at the ends, ridged on the back, with a broad high grooved ridge, 7–7.5 mm. long, and about 4 mm. wide.

A slender shrub 2–3 m. high, with small stems covered with smooth pale bark, small spreading branches, and very slender slightly zigzag branchlets dark orange-green more or less tinged with red and marked by pale lenticels when they first appear, becoming bright chestnut-brown and very lustrous in their first season and dull dark gray-brown the following year, and armed with occasional stout straight spines.

Rocky hills and barrens, near Swan, Taney County, *B. F. Bush,* (No. 4 A type) September 22, 1905, May 17 and October 7, 1907, (Nos. 4, 4 B, 4 D) September 22, 1905, May 17, 1907, (Nos. 4 C, A. F, G, M) September 23, 1905.

UNIFLORAE.

Leaves oblong-obovate, cuneate at the base; petioles short; flowers in 2- or 3-flowered hoary-tomentose corymbs; stamens 20; anthers yellow; fruit obovate, light orange-red, lustrous, up to 1.4 cm. long; nutlets 3 or 4, acute at the ends.

1. CRATAEGUS TRIANTHOPHORA Sargent, Trees and Shrubs, ii. 11, t. 106 (1907).

Dry open woods, near Grandin, Carter County, *B. F. Bush* (No. 12 type), May and October, 1905.

MICROCARPAE.

Flowers not more than 1 cm. in diameter, in many-flowered glabrous corymbs; stamens 20; anthers rose color; fruit depressed-globose, scarlet, not more than 6 mm. in diameter; leaves broadly ovate to triangular.

1. CRATAEGUS CORDATA Aiton, Hort. Kew. ii. 168 (1788).—Torrey & Gray, Fl. N. Am. i. 467.—Chapman, Fl. 127.—Watson & Coulter, Gray's Man. ed. 6, 165.—Sargent, Garden and Forest, ii. 423, f. 126; Silva N. Am. iv. 107, t. 186; Manual, 487, f. 402.

Pleasant Grove, Grandin; and Birch Tree, Shannon County, Williamsville, Wayne County, Bismarck, St. François County; also southern Illinois and through middle Kentucky and Tennessee to Virginia, and along the Appalachian foothills from Virginia to middle Georgia and to Alabama.

TOMENTOSAE.

Fruit obovate to subglobose or short-oblong, orange-red, scarlet or rarely green, usually becoming soft and succulent at maturity, 6–12 mm. in diameter; nutlets 2 or 3, obtuse at the ends, prominently ridged on the back; flowers small, opening late, in tomentose or villose usually many-flowered corymbs; leaves thin to subcoriaceous, more or less pubescent below during the season.

Leaves thin, with midribs and veins only slightly impressed on their upper surface.

Anthers rose color (pink in No. 2).

Stamens 20.

Fruit obovate; flowers in wide many-flowered corymbs.

Fruit up to 1 cm. in length, dull orange-red; leaves ovate to oblong; branchlets ashy gray, usually unarmed or with occasional small gray spines. 1. *C. tomentosa.*

Fruit not more than 8 mm. in diameter; leaves broadly ovate to broadly oval, branchlets light chestnut-brown and lustrous, armed with numerous long purple spines; anthers pink. 2. *C. hispidula.*

Fruit short-oblong to oval or slightly obovate, up to 1 cm. in length; flowers in compact mostly 3–8-flowered corymbs; leaves ovate to obovate. 3. *C. missouriensis.*

Fruit globose to short-oblong, not more than 8 mm. in diameter; flowers in 12–15-flowered corymbs; leaves slightly obovate to oval or ovate. 4. *C. globosa.*

Stamens 5–10.

Fruit obovate, 7–8 mm. in length; leaves ovate to rhombic; stamens 7–10. 5. *C. obscura.*

Fruit short-oblong to subglobose.

Flowers in many-flowered corymbs.

Leaves broadly ovate; stamens 10. 6. *C. spinulosa.*

Leaves ovate to oval; stamens 5–8, usually only 5. 7. *C. mollita.*

Flowers in mostly 5–8-flowered corymbs; leaves ovate to obovate; stamens 5–10. 8. *C. rupicola.*

Anthers yellow; stamens 10.

Leaves narrowly obovate to rhombic or ovate; fruit short-oblong, green or yellowish red. 9. *C. pudens.*

Leaves ovate to oval or obovate; fruit subglobose to short-oblong, bright orange-red. 10. *C. mollicula.*

Leaves subcoriaceous, with midribs and veins deeply impressed on their upper surface and pubescent below; flowers in many-flowered corymbs.

Stamens 20.

Leaves broadly ovate to broadly obovate, rather thick; anthers dark red; fruit obovate. 11. *C. insperata.*

Leaves rhombic to slightly obovate, thicker; anthers pale salmon color. 12. *C. ensifera.*

Stamens 10; anthers yellow; leaves ovate to rhombic; fruit subglobose to short-oblong. 13. *C. pertomentosa.*

1. Crataegus tomentosa Linnaeus Spec. 476 (1753).—Torrey & Gray, Fl. N. Am. i. 465.—Chapman, Fl. 127.—Watson & Coulter, Gray's Manual, ed. 6, 166.—Sargent, Silva N. Am. iv. 101, t. 183; Proc. Phil. Acad. Sci. 1905, 656; Manual, 492; Rep. Geolog. Surv. Michigan, 1906, 560.

Allenton, St. Louis County, *G. W. Letterman*, April 25, 1880, May 10, 1881, October 1882, June 1, 1883; near Webster, St. Louis County, *H. Eggert*, May 24, 1887; also through Illinois, southern Michigan, Ontario, western New York and Pennsylvania.

2. Crataegus hispidula, n. sp.

Leaves broadly ovate to broadly oval, acuminate, abruptly cuneate or rounded at the base, sharply often doubly serrate above, with long straight glandular teeth, and slightly divided into 4 or 5 pairs of small acuminate spreading lobes; about one-third grown when the flowers open from the 15th to the 25th of May and then thin, dark green, scabrous, and slightly hairy on the midribs above, and pale and villose on the midribs and veins below, and at maturity thin, yellow-green and scabrate on the upper surface, still slightly villose on the lower surface on the prominent midribs and primary veins, 6–8 cm. long and 5–7 cm. wide; petioles stout, broadly wing-margined nearly to the base, villose, 1–1.5 cm. in length; leaves on vigorous shoots ovate, acuminate, abruptly concave-cuneate at the base, more coarsely serrate and more deeply lobed, often 8 to 9 cm. long and 6–7 cm. wide, with broad-winged petioles, and foliaceous lunate coarsely glandular-serrate persistent stipules sometimes 2 cm. in length. Flowers about 1 cm. in diameter, on short stout hoary-tomentose pedicels, in compact tomentose mostly 12–20-flowered corymbs, the short lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, thickly coated with long matted white hairs, the lobes short, slender, acuminate, laciniately glandular-serrate, glabrous on the outer, villose on the inner surface, reflexed after anthesis; stamens 20; anthers pale pink; styles 2 or 3, usually 2. Fruit ripening early in October, on slender hairy pedicels, in wide spreading many-fruited clusters, obovate, full and rounded at the apex, gradually narrowed at the base, slightly hairy at the ends, orange-red, 7–8 mm. long and 6–7 mm. in diameter; calyx prominent, with a deep narrow cavity pointed in the bottom, and much enlarged foliaceous coarsely serrate spreading persistent lobes sparingly villose and dark red on the upper side below the middle; flesh thin, yellow, sweet, becoming succulent; nutlets usually 2, gradually narrowed and rounded at the ends, ridged on the back, with a broad low ridge, penetrated on the inner faces with shallow cavities, 4.5–5 mm. long, and 3–3.5 mm. wide.

A shrub 2 or 3 m. high, with stems sometimes 3 cm. in diameter, small ascending branches, and slender nearly straight branchlets light orange-green and thickly covered with long white hairs when they first appear, becoming bright chestnut-brown, lustrous and marked by pale lenticels in their first season and dull red-brown the following year, and armed with numerous very slender nearly straight purplish spines 3–4 cm. long, persistent and compound on old stems.

Limestone cliffs of Spring River, Carthage, Jasper County, *E. J. Palmer*, (No. 9 D type) May 24, and October 27, 1901, October 27, 1902.

3. CRATAEGUS MISSOURIENSIS Ashe, Bull. N. C. College of Agriculture and Mechanic Arts, No. 175, 110 (1900).

Leaves ovate to obovate, acute and short-pointed at the apex, cuneate at the entire base, and coarsely often doubly serrate, with straight glandular teeth; nearly fully grown when the flowers open about the middle of May and then thin, yellow-green, lustrous and roughened above by short white hairs and paler and villose below especially on the slender midribs and primary veins, and at maturity thin, dark yellow-green, lustrous and scabrate on the upper surface, pale and still villose on the lower surface, 3.5–4.5 cm. long and 2.5–3 cm. wide; petioles slender, narrowly wing-margined, densely villose while young, often becoming nearly glabrous, 4–6 mm. in length; leaves on vigorous shoots oval, acute or acuminate at the ends, more coarsely serrate, occasionally slightly lobed, frequently 6–7 cm. long and 4–5 cm. wide. Flowers bad-smelling, 1.2–1.5 cm. in diameter, on slender hoary-tomentose pedicels, in small compact mostly 3–8-flowered tomentose corymbs, the lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, hoary-tomentose, the lobes long, slender, acuminate, laciniately glandular-serrate, sparingly villose or glabrous on the outer surface, villose on the inner surface, reflexed after anthesis; stamens 20; anthers rose color; styles 3–5, surrounded at the base by a ring of pale hairs. Fruit ripening early in October, on stout erect or spreading slightly hairy pedicels, solitary or in few-fruited clusters, short-oblong to oval or slightly obovate, bright orange-red, lustrous, 11–12 mm. long and 9–10 mm. in diameter; calyx prominent, with a short tube, a deep narrow cavity tomentose in the bottom, and elongated spreading lobes; flesh thin, yellow, sweet and succulent; nutlets 3–5, gradually narrowed and rounded at the ends or acute at the base, ridged on the back, with a broad high grooved ridge, penetrated on the inner faces by very shallow broad cavities, 4–4.5 mm. long, and 3–3.5 mm. wide.

A shrub 1–2 m. high, with slender branchlets thickly coated when they first appear with long matted white hairs, becom-

ing dark dull purple and pubescent in their first season and grayish brown the following year, and armed with numerous very slender straight purple ultimately gray spines 3.5–5 cm. long.

Bluffs and rocky banks of small streams, Monteer, Shannon County, *B. F. Bush,* (No. 277 type) July 29, 1899, (Nos. 383 and 387) May 25, 1900, (No. 504) May 16, 1901, (Nos. 3, 3 A, 3 B, 3 C, 3 E, 3 F, 3 H, 3 I) May and October 1905; Birch Tree, Shannon County, *B. F. Bush,* (No. 293, described as a slender tree) July 29, 1899, (No. 390) May 26, 1900; Pleasant Grove, Ripley County, *B. F. Bush,* (No. 455, described as a slender tree) August 10, 1899.

4. Crataegus globosa, n. sp.

Leaves slightly obovate to oval or ovate, acuminate, gradually narrowed and concave-cuneate at the entire base, coarsely doubly serrate above, with straight glandular teeth, and occasionally very slightly divided above the middle into 3 or 4 pairs of small acute lobes; nearly fully grown when the flowers open about the middle of May and then thin, yellow-green, covered above by short white hairs and pubescent below, and at maturity thin, dark yellow-green, lustrous and scabrate on the upper surface and pale and pubescent on the lower surface especially along the slender yellow midribs and primary veins, 6–8 cm. long and 4.5–5.5 cm. wide; petioles stout, narrowly wing-margined to below the middle, villose early in the season, becoming puberulous, 1–1.2 cm. in length; leaves on vigorous shoots ovate to oval, more coarsely serrate, rarely slightly lobed, often 9–10 cm. long and 6–7 cm. wide. Flowers 1.4–1.5 cm. in diameter, on slender hoary-tomentose pedicels, in compact mostly 12–15-flowered corymbs, with linear-obovate to linear minutely glandular bracts and bractlets fading brown and often persistent until the flowers open, the long slender tomentose lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, densely tomentose, the lobes narrow, acuminate, finely glandular-serrate, pubescent on the outer, villose on the inner surface, reflexed after anthesis; stamens 20; anthers large, rose color; styles 2, surrounded at the base by a narrow ring of pale hairs. Fruit ripening early in October, on stout slightly hairy drooping pedicels, in many-fruited clusters, often persistent until after the leaves fall, globose or short-oblong, light orange-red, lustrous, marked by large dark dots, 7–8 mm. in diameter; calyx little enlarged, with a wide shallow cavity, and slender closely appressed often deciduous lobes; flesh thin, yellow, dry and hard, becoming soft after frost; nutlets 2, full and rounded at the ends, ridged on the back, with a broad low slightly grooved ridge, penetrated on the inner face by very large shallow cavities, 5.5–6 mm. long, and 3.5–4 mm. wide.

A slender shrub 5–8 m. high, with numerous small stems, and slender nearly straight branchlets covered when they first appear with long matted white hairs, becoming light chestnut-brown, puberulous, and marked by pale lenticels in their first season and dull gray-brown the following year, and armed with very numerous stout straight chestnut-brown shining spines 5–6 cm. long.

Dry gravelly banks of small streams near Monteer, Shannon County, *B. F. Bush*, (No. 7 B type), May 17 and Oct. 1, 1905, (No. 7) Oct. 6, 1905, (No. 7 A) Oct. 6, 1905, (No. 7 C) Oct. 1, 1905. To this species appear to belong the following specimens: Swan, Taney County, *B. F. Bush*, (No. 10) May 21 and September 22, 1905, (Nos. 10 B, 10 C and 10 D) September 1905, (No. 10 E), May 19, 1907; Christian County, near Swan, *B. F. Bush*, (No. 10 F) May 21, 1907, (No. P) September 25, 1905.

5. **Crataegus obscura,** n. sp.

Leaves ovate to rhombic, acuminate, concave-cuneate at the entire base, sharply often doubly serrate above, with straight glandular teeth, and divided above the middle into 4 or 5 pairs of long slender acuminate lobes; fully grown when the flowers open about the middle of May and then thin, yellow-green, strigose above and villose along the upper side of the midribs and soft-pubescent below, and at maturity thin, light yellow-green and scabrate above, and paler and pubescent below especially on the slender midribs, and thin primary veins extending obliquely to the points of the lobes, 6–7.5 cm. long and 4–6 cm. wide; petioles stout, narrowly wing-margined nearly to the base, densely villose while young, becoming nearly glabrous, 1.5–1.8 cm. in length. Flowers 1–1.2 cm. in diameter, on slender densely villose pedicels, in mostly 12–15-flowered hairy corymbs, the much elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, thickly covered with matted white hairs, the lobes long, slender, acuminate, glandular-serrate, sparingly villose, reflexed after anthesis; stamens 7–10; anthers rose color; styles 2 or 3, surrounded at the base by a narrow ring of pale tomentum. Fruit ripening early in October, on stout hairy erect pedicels, in few-fruited clusters, obovate, full and rounded at the apex, abruptly narrowed at the base, light orange-red, lustrous, marked by small pale dots, 1–1.2 cm. long and 9–10 mm. in diameter; calyx little enlarged, with a very narrow shallow cavity, and elongated slender laciniately serrate spreading and incurved often deciduous lobes; flesh thin, pale yellow, soft and succulent; nutlets 2 or 3, usually 2, rounded at the ends, ridged on the back, with a narrow low ridge, penetrated on the inner faces by broad shallow cavities, about 6 mm. long, and 2 mm. wide.

A shrub 1–3 m. high, with slender stems covered with smooth dark bark, small ascending branches, and slender nearly straight branchlets loosely coated with long white hairs when they first appear, light orange-brown and pubescent at the end of their first season, becoming rather lighter-colored the following year, and armed with very numerous slender nearly straight purple ultimately ashy gray spines 3–6 cm. long and generally pointing toward the base of the branch.

Limestone cliffs of Centre Creek, near Webb City, Jasper County, *E. J. Palmer*, (No. 9 C type) May 18, 1902, October 4, 1907.

6. **Crataegus spinulosa,** n. sp.

Leaves broadly ovate, acuminate, abruptly concave-cuneate at the entire base, sharply often doubly serrate above, with straight glandular teeth, and slightly divided usually only above the middle into 3 or 4 pairs of small spreading acuminate lobes; nearly fully grown when the flowers open about the 20th of May and then thin, dark yellow-green and roughened above by short white hairs and villose-pubescent below, and at maturity rather thick, dark yellow-green, scabrate and lustrous on the upper surface, paler and still villose on the lower surface especially on the stout yellow midribs, and conspicuous primary veins extending very obliquely to the points of the lobes, 5.5–8 cm. long and 4.5–6 cm. wide; petioles stout, narrowly wing-margined nearly to the base, villose, occasionally glandular, 1–1.5 cm. in length. Flowers 1.2–1.4 cm. in diameter, on long stout villose pedicels, in wide hairy mostly 15–25-flowered corymbs, the much elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, coated with long matted white hairs, the lobes gradually narrowed from the base, long, wide, sharply glandular-serrate, slightly villose, reflexed after anthesis; stamens 10; anthers bright rose color; styles 2 or 3. Fruit ripening early in October, on short stout slightly hairy pedicels, in few-fruited drooping clusters, short-oblong, slightly narrowed and hairy at the ends, orange-red, lustrous, 7–8 mm. long and 5–6 mm. in diameter; calyx little enlarged, with a deep narrow cavity, and small spreading and appressed lobes; flesh thin, yellow, soft and juicy; nutlets usually 2, rounded at the ends, ridged on the back, with a broad low grooved ridge, deeply penetrated on the inner face by long narrow cavities, 5.5–6 mm. long, and 3–3.5 mm. wide.

A shrub 2–3 m. high, with small stems covered with pale gray bark, slender nearly straight branchlets dark orange-green, marked by large pale lenticels and coated with long matted white hairs when they first appear, still hairy and light chestnut-brown at the end of their first season and dull

gray-brown the following year, and unarmed or armed with occasional slender straight light chestnut-brown spines 3–5 cm. long.

Low moist soil by streams, near Webb City, Jasper County, *E. J. Palmer*, (No. 9 A type) May 20 and October 13, 1901, May 19, 1903, (No. 14) *C. S. Sargent*, October 2, 1901.

7. CRATAEGUS MOLLITA Sargent, Trees and Shrubs, ii. 77, t. 136 (1908).

Gravelly banks of streams, Swan, Taney County, *B. F. Bush*, (No. 11 B type) May and September 1905, May 1907, also numbers 11, 11 A, 11 C and 11 D.

8. **Crataegus rupicola**, n. sp.

Leaves ovate to obovate, acute or acuminate, gradually narrowed and concave-cuneate at the glandular base, coarsely doubly serrate above, with straight glandular teeth, slightly divided usually only above the middle into 3 or 4 pairs of small acuminate lobes, strigose and becoming scabrate on the upper surface, and covered on the lower side of the stout midribs and slender prominent veins and veinlets with long white rather rigid hairs; nearly fully grown when the flowers open from the 15th to the 20th of May and then light yellow-green, and at maturity thin but firm in texture, yellow-green, 7–8 cm. long and 5–6 cm. wide; petioles slender, broadly wing-margined at the apex, densely villose-pubescent, glandular, with minute persistent glands, 1.5–2.5 cm. in length; leaves on vigorous shoots coarsely serrate, more deeply lobed, and often 8–10 cm. long and 6–7 cm. wide, with stout broad-winged petioles. Flowers 1.6–1.7 cm. in diameter, on short slender densely villose pedicels, in 5–8-flowered hairy corymbs, with lanceolate to linear glandular bracts and bractlets fading brown and often persistent until the flowers open, the lower peduncles from the axils of upper leaves; calyx-tube densely covered with matted pale hairs, the lobes wide, long-pointed and acuminate at the apex, villose, reflexed after anthesis; stamens 5–10; anthers large, bright red; styles 2–4, usually 3, surrounded at the base by a broad ring of long white hairs. Fruit ripening and falling early in October, on stout erect or spreading villose pedicels, in few-fruited clusters, subglobose to short-oblong, deeply concave at the insertion of the stem, bright orange-red, villose, with long soft white hairs most abundant at the rounded ends, 9–11 mm. in diameter; calyx little enlarged, with a broad deep cavity lined with hoary tomentum, and small spreading closely appressed lobes; flesh yellow-green, thick, dry and mealy; nutlets 2–4, obtuse and rounded at the ends, or when 4 narrowed at the ends, prominently ridged on the back, with a high deeply grooved ridge, penetrated on the inner faces by narrow deep cavities, 5.5–6 cm. long, and 4–4.5 mm. wide.

A slender shrub 2–4 m. high, with small stems covered with dark scaly bark, small spreading and ascending branches forming an open irregular head, and slender slightly zigzag branchlets dark green and hoary-tomentose when they first appear, becoming light chestnut-brown, lustrous and villose-pubescent or almost glabrous in their first season and dull reddish brown or gray in their second year, and armed with numerous slender nearly straight purplish shining spines 2–5 cm. long.

Dry rocky hills and barrens, and the dry banks of small streams, Swan, Taney County, *B. F. Bush*, (No. 3 A type) May 21 and September 22, 1905, (No. 3) May 19, 1905, (No 3 B) September 25, 1905, also *Trelease* and *Sargent*, October 8, 1899 (without number).

9. **Crataegus pudens,** n. sp.

Leaves narrowly obovate to rhombic or ovate, acuminate, gradually narrowed to the long concave-cuneate entire base, and coarsely doubly serrate above, with straight glandular teeth; more than half-grown when the flowers open about the middle of May, and then thin, yellow-green, setose, and villose along the midribs above, and pubescent below, and at maturity thin but firm in texture, dark green, scabrate and lustrous on the upper surface, pale bluish green and rough-pubescent on the lower surface, 5–6 cm. long and 3–3.5 cm. wide, with slender villose midribs and primary veins; petioles stout, wing-margined to below the middle, densely villose early in the season, becoming glabrous, 1–1.2 cm. in length; leaves on vigorous shoots thicker, usually broadly obovate, coarsely serrate, often 6.5–7.5 cm. long and 5–6 cm. wide, with narrow foliaceous falcate glandular-serrate stipules. Flowers 1.4–1.5 cm. in diameter, on long slender villose pedicels, in wide lax mostly 15–20-flowered corymbs, with oblong-obovate to linear minutely glandular bracts and bractlets fading brown and usually persistent until the flowers open, the long slender villose lower peduncles from the axils of the upper leaves; calyx-tube narrowly obconic, thickly coated with long matted pale hairs, the lobes wide, long-pointed and acuminate, glandular-serrate, glabrous on the outer, villose on the inner surface, reflexed after anthesis; stamens 10; anthers pale yellow; styles 2 or 3, surrounded at the base by a broad ring of white hairs. Fruit ripening the end of September, on long drooping slightly hairy pedicels, in broad many-fruited clusters, short-oblong, full and rounded at the ends, green to yellowish red, 9–10 mm. long and 8–9 mm. in diameter; calyx little enlarged, with a very narrow deep cavity, and small spreading lobes often deciduous from the ripe fruit; flesh thin, yellow-green, hard and dry; nutlets 2 or 3, usually 2, full and rounded at the ends, ridged on the back, with a broad high grooved ridge, irregularly penetrated on the inner faces by shallow cavities, 6–7 mm. long, and 4.5–5 mm. wide.

A shrub 3–5 m. high, with numerous small stems, slender nearly straight branchlets thickly covered when they first appear with long matted white hairs, becoming bright chestnut-brown, very lustrous, and marked by many small pale lenticels in their first season, and dull reddish brown the following year, and armed with very numerous slender slightly curved purplish shining spines 4–5 cm. long and often pointing toward the base of the branch.

Gravelly banks of small streams, near Monteer, Shannon County, *B. F. Bush* (No. 11 type), May 15 and Oct. 3, 1905, (No. 11 A) May 15, 1905, (No. 11 B) May 15 and Oct. 7, 1905.

10. CRATAEGUS MOLLICULA Sargent, Trees and Shrubs, ii. 13, t. 107 (1907).

Rocky banks of streams, Monteer, Shannon County, *B. F. Bush*, (No. 8 type) May and October 1905.

11. **Crataegus insperata, n. sp.**

Leaves broadly ovate to broadly obovate, acute or acuminate at the apex, gradually or abruptly narrowed to the concave-cuneate entire base, sharply often doubly serrate above, with straight slender glandular teeth, and divided above the middle into 3 or 4 pairs of narrow acuminate lobes; fully grown when the flowers open about the 20th of May and then thin, light yellow-green and roughened above by short white hairs and soft-pubescent below especially on the midribs and veins, and at maturity rather thick, dark yellow-green and scabrate on the upper surface and pale bluish green and still pubescent on the stout midribs and slender primary veins on the lower surface, 5–6 cm long and 3–5 cm. wide; petioles stout, wing-margined nearly to the base, villose early in the season, becoming glabrous, rose-colored in the autumn, 7–10 mm. in length. Flowers about 1 cm. in diameter, on slender pedicels covered with matted pale hairs, in compact 15–20-flowered hairy corymbs, with linear acuminate glandular-serrate bracts and bractlets fading brown and frequently persistent until the flowers open, the long lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, hairy like the pedicels, the lobes long, slender, acuminate, laciniately serrate, villose on the two surfaces, reflexed after anthesis; stamens 20; anthers dark red; styles 2 or 3, surrounded at the base by a ring of pale hairs. Fruit ripening in October, on stout reddish slightly hairy pedicels, in few-fruited clusters, obovate, light orange-red, lustrous, 1–1.2 cm. long and 8–10 mm. in diameter; calyx little enlarged, with a short pubescent tube, a narrow deep cavity, and small spreading and reflexed often deciduous lobes; flesh thick, yellow, sweet and succulent; nutlets 2 or 3, full and rounded, or when 3 narrowed and rounded at the ends, ridged on the back, with a broad low grooved ridge, deeply penetrated on

the inner faces by very broad deep cavities, about 6 mm. long, and 3 mm. wide.

A shrub 1.5–2 m. high, with small stems covered with dark bark, small ascending and spreading branches, and slender nearly straight branchlets orange-green and loosely covered with matted white hairs when they first appear, dull reddish brown and slightly pubescent at the end of their first season, becoming dark dull red-brown and glabrous the following year, and unarmed or armed with occasional slender short spines.

Rocky banks of Spring River, Carthage, Jasper County, *E. J. Palmer*, (No. 9 H type) May 19 and October 5, 1907.

With leaves considerably thicker than those of the other Missouri thin-leaved Tomentosae and thinner than those of the two Missouri thick-leaved species, *Crataegus insperata* serves to connect these two divisions of the group. The prominent midribs and veins impressed above indicate, however, a closer relationship with the thick-leaved species with which I have placed it.

12. Crataegus ensifera, n. sp.

Leaves rhombic to slightly obovate, acuminate at the ends, finely doubly serrate, with straight glandular teeth, and slightly divided above the middle into 3 or 4 pairs of small acuminate lobes; nearly fully grown when the flowers open from the 10th to the middle of May and then thin but firm in texture, dark yellow-green, lustrous, and roughened above by short white hairs and pale yellowish green and sparingly villose along the midribs and veins below, and at maturity thick, light yellow-green and scabrate above, pale and pubescent below, 5–6 cm. long and 3–3.5 cm. wide, with stout midribs, and thin prominent primary veins deeply impressed on the upper side of the leaf; petioles slender, narrowly wing-margined to below the middle, villose on the upper side while young, becoming glabrous, bright rose color in the autumn, 1–1.5 cm. in length. Flowers 1.3–1.4 cm. in diameter, on long slender slightly hairy pedicels, in wide mostly 16–20-flowered corymbs, the elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, slightly hairy near the base, glabrous above, the lobes long, wide, laciniately glandular-serrate, glabrous on the outer, villose on the inner surface, reflexed after anthesis; stamens 20; anthers minute, pale salmon color; styles 2. Fruit ripening and falling early in October, on slender drooping slightly pubescent pedicels, in few-fruited clusters, oval, bright orange-red, lustrous, marked by small pale dots, 1–1.2 cm. long and 8–9 cm. in diameter; calyx prominent, with a wide deep cavity, and small spreading and appressed coarsely serrate lobes,

flesh thin, yellow, sweet and succulent; nutlets 2, rounded at the ends, ridged on the back, with a low ridge, penetrated on the inner faces by narrow deep cavities, 5.5–6 mm. long, and 2–2.5 mm. wide.

A tree 7–8 m. high, with a trunk sometimes 2 dm. in diameter, small ascending and spreading branches, and stout slightly zigzag glabrous branchlets light green when they first appear, becoming bright chestnut-red, very lustrous and marked by dark lenticels in their first season and dark reddish brown the following year, and armed with very numerous stout slightly curved bright chestnut-brown ultimately ashy gray spines 4.5–8 cm. long.

Roadside five miles north of Swan, in Christian County, *B. F. Bush*, (No. 23 B type) May 16 and October 6, 1907, (Nos. 23 and 23 A) May 16, 1907, (No. 23 C) May 16 and October 6, 1907.

13. CRATAEGUS PERTOMENTOSA Ashe, Jour. Elisha Mitchell Sci. Soc. xvi. pt. ii. 70 (1900).—Mackenzie & Bush, Manual Fl. Jackson County, Missouri, 108.

Leaves ovate to rhombic, acuminate, gradually narrowed and concave-cuneate at the entire base, sharply often doubly serrate above, with straight glandular teeth, and occasionally slightly divided above the middle into small acute lobes; about half-grown when the flowers open the middle of May and then thin, bluish green, villose on the upper side of the midribs and roughened above by short white hairs, and pale and villose below especially on the midribs and veins, and at maturity subcoriaceous, lustrous and scabrate on the upper surface, still villose on the lower surface, 5–5.5 cm. long and 3–4 cm. wide, with stout midribs often rose-colored in the autumn, and slender primary veins deeply impressed on the upper side of the leaves; petioles stout, wing-margined at the apex, sparingly villose early in the season, becoming glabrous, 8–10 mm. in length; leaves on vigorous shoots thicker, broadly ovate to oval, acute at the apex, rounded or concave-cuneate at the base, more coarsely serrate, often more deeply lobed, frequently 6–7 cm. long and 5.5–6.5 cm. wide. Flowers 1.5–1.6 cm. in diameter, on long slender densely villose pedicels, in wide mostly 18–20-flowered hairy corymbs, with linear-lanceolate to linear acuminate finely glandular-serrate bracts and bractlets fading brown and generally persistent until the flowers open, the much elongated lower peduncles from the axils of upper leaves; calyx-tube narrowly obconic, densely villose, the lobes long, slender, acuminate, laciniately glandular-serrate below the middle, glabrous on the outer, villose on the inner surface, reflexed after anthesis; stamens 10; anthers pale yellow; styles 2, surrounded at the base by a broad ring of pale hairs. Fruit ripening late in September

or in October, on long slender hairy pedicels, in many-fruited drooping clusters, subglobose to short-oblong, scarlet, lustrous, marked by small pale dots, 8–9 mm. in diameter; calyx little enlarged, with a narrow shallow cavity and spreading often deciduous lobes; flesh thin, yellow, sweet and succulent; nutlets 2, rounded at the ends, slightly ridged on the back, penetrated on the inner faces by deep narrow cavities, about 6 mm. long, and 2.5 mm. wide.

A shrub 2–6 m. high, with slender stems covered with gray scaly bark, spreading branches, and stout slightly zigzag branchlets dark reddish brown marked by pale lenticels and sparingly villose when they first appear, becoming light chestnut-brown, glabrous and very lustrous in their first season and pale gray-brown the following year, and armed with numerous stout or slender nearly straight purple shining spines 3–6 cm. long.

Rocky barrens, Jackson County; widely distributed but not common, *B. F. Bush*, Grain Valley, Dodson, Independence.

Arnold Arboretum.

ADDENDUM.*

2. CRATAEGUS APIIFOLIA Michaux, Fl. Bor.-Am. i. 287. (1803).—Chapman, Fl. 127.—Sargent, Silva N. Am. iv. 111, t. 188; Manual, 486, f. 401.

Neelyville, Butler County, *B. F. Bush* (No. 47), April 22, 1898; also from Arkansas, eastern Texas, and to Florida and southern Virginia.

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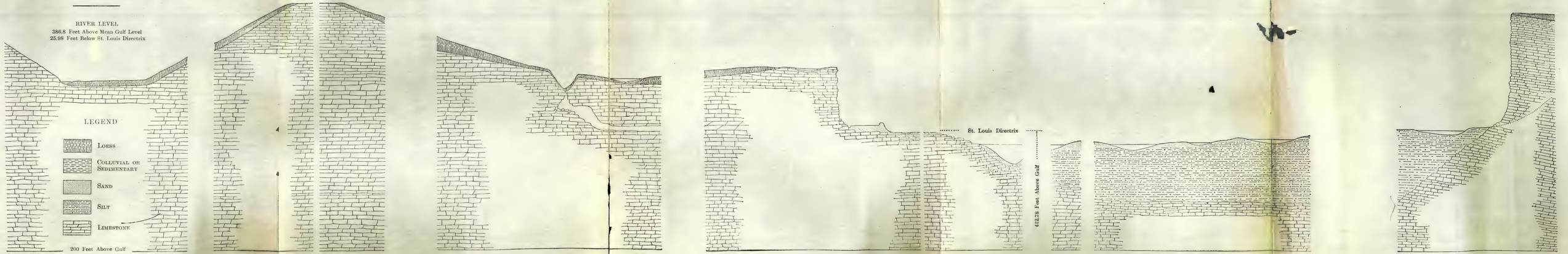
* p. 114, under MICROCARPAE.

Ideal Cross Section
of the
Mississippi River

SCALE
1 Inch = 50 Feet
(In Breaks 1 Inch = 1 Mile

RIVER LEVEL
386.8 Feet Above Mean Gulf Level
25.98 Feet Below St. Louis Directrix



AN ECOLOGICAL CROSS SECTION OF THE MISSISSIPPI RIVER IN THE REGION OF ST. LOUIS, MISSOURI.*

BY HENRI HUS.

INTRODUCTION.

The diversity of physiographic conditions afforded by a great river like the Mississippi always offers an incentive to a study of the distribution of the vegetation about it. This is particularly true of the Mississippi in the region of St. Louis, Mo. Here it traverses a valley from four to eight miles broad of which a portion, approximately one mile in width, is occupied by the stream. The greater part of its alluvial flood plain lies in Illinois, there forming the most northern portion of the American Bottom. This flood plain is modified by numerous agents either natural or artificial. Bodies of water, varied in extent, occupy a large area. While some of them are connected with the river at all times, others are so only in times of flood. Creeks, descending from the plateau, cut their way to the Mississippi. The land itself is high or low, sandy or clayey. Portions of it have been diked. Wooded tracts have been denuded for agricultural purposes. The resulting diversity of vegetation finds a parallel in that of the plateaus of Missouri and Illinois, both originally forming part of the same peneplain. These plateaus have been modified by various physical agents. Water is responsible for the formation of ravines and sinkholes. Under the influence of man large portions of the original forest have disappeared. Farms now occupy their place. Naturally these influences have gone far to modify the original vegetation. Contemporaneous with the recession, or even disappearance, of a species is the advent and establishment of another. Railroads, bringing about entirely new conditions, have offered favorable opportunities for the development and distribution of certain species, at the same time assisting in the immigration of others. It is realized that where the secondary influences act upon a country already modeled

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* A thesis presented to the Faculty of Washington University, in candidacy for the degree of Doctor of Philosophy, April. 1908.

into distinct regions by primary physiographic forces, the effect upon the flora must be far reaching. In the following paper an attempt has been made to analyze the physiographic features of the river valley and to study the distribution of the local flora with reference to them.

Since a cross section of the Mississippi River, following a straight line laid down with mathematical precision, would not include the various features characteristic of the region described, the cross section made is an ideal one, exemplified in the accompanying diagram, embodying the principal physiographic features of the region studied. The section embraces, from east to west, the country lying between the rolling prairies of southwestern Illinois on the one hand and the Missouri plateau on the other, and includes portions of the two plateaus. On the Missouri side the area covered comprises the country between the mouth of the River des Pères and the mouth of the Meramec River. On the Illinois side the territory is bounded on the north by an east and west line drawn through a point approximately one mile north of Collinsville in Madison county and on the south by an east and west line drawn through a point about two miles south of Falling Spring, St. Clair county.

In the collection of data for and in the preparation of this paper the writer is indebted for valuable assistance to many friends, in the first place to Professor William Trelease, at whose suggestion the work was undertaken. To Professor Fenneman of the U. S. Geological Survey, to Messrs. Mitchell and Penneman of the Deep Water Way Commission, and to Mr. J. J. Lichter, thanks are due for information along geological lines, especially as far as borings in the American Bottoms are concerned, and to Mr. J. H. Kellogg of the Missouri Botanical Garden for numerous botanical data.

PHYSICAL FEATURES.

METEOROLOGY.

As pointed out by Clements,* unless meteorological readings are taken in each habitat, they are of no value to the ecologist

* Clements, F. E. Research Methods in Ecology. Lincoln. 1905.

except in giving a very general idea of the vegetation. Neither annual nor daily averages can be used to advantage. It is different where monthly or seasonal averages are concerned. The extremes also are of importance. For this reason certain of the data collected by others are given here.

TABLE A.

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	An'l
1873				51	65	78	78	78	67	**52**	42	36	
1874	35	36	43	**47**	69	79	81	78	70	58	44	38	56
1875	23	26	40	51	64	72	78	**73**	67	54	41	44	**53**
1876	41	41	40	58	67	73	79	78	67	56	42	**25**	66
1877	31	42	39	55	64	74	78	76	70	61	43	48	57
1878	36	41	**54**	61	64	73	82	79	69	57	47	27	57
1879	28	34	48	55	69	74	81	76	66	64	48	35	56
1880	**47**	41	43	58	70	74	78	80	68	56	**33**	28	56
1881	**22**	31	40	52	72	76	82	**84**	**77**	62	44	42	57
1882	34	**45**	47	59	**60**	74	**75**	76	70	62	45	33	57
1883	24	31	40	57	63	73	78	75	68	57	50	41	55
1884	26	37	44	55	65	74	79	75	75	64	47	34	56
1885	26	27	41	57	65	75	82	76	69	57	48	39	55
1886	26	37	45	59	69	75	81	79	72	61	46	30	57
1887	31	41	46	61	71	77	84	79	70	54	45	32	**58**
1888	25	33	41	59	63	74	80	75	67	55	45	38	55
1889	35	31	47	58	64	71	78	75	67	55	41	**50**	56
1890	39	40	39	57	64	79	80	75	**65**	57	49	38	57
1891	37	36	39	59	64	76	**75**	75	74	58	41	43	56
1892	26	40	40	54	63	77	77	78	70	60	42	33	55
1893	25	31	44	57	64	75	80	76	73	59	44	36	55
1894	36	32	51	58	66	78	79	79	71	60	42	39	**58**
1895	26	25	44	60	67	77	76	78	74	54	43	37	55
1896	35	37	41	**65**	**73**	74	79	79	68	57	46	41	**58**
1897	31	37	47	56	64	75	81	77	**77**	**66**	46	33	57
1898	37	38	47	54	67	78	78	78	74	56	43	33	57
1899	33	24	40	58	69	77	79	81	70	64	52	33	57
1900	37	30	43	58	69	74	79	**84**	74	**66**	47	38	**58**
1901	37	31	45	54	66	**81**	**87**	80	72	62	44	30	57
1902	32	26	47	55	72	74	80	76	66	62	**53**	34	57
1903	34	34	49	57	69	**70**	81	77	70	59	42	30	56
1904	28	31	45	49	65	72	76	74	71	59	48	**35**	54
1905	24	**23**	50	56	67	76	75	78	71	56	47	35	55
1906	37	32	**34**	60	67	72	77	78	73	57	44	37	56
1907	36	34	53	**47**	59	71	79	77	69	56	44	38	55

MONTHLY AND ANNUAL MEAN TEMPERATURES.*

* U. S. D. A. Weather Bureau. Annual Meteorological Summary, St. Louis, 1907.—In these tables, the Fahrenheit scale is used.—Highest and lowest temperatures in bold-face type.

TABLE B.

MONTHLY AND ANNUAL PRECIPITATION.*

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	An'l
1871	2.53	2.92	1.27	0.49	3.15	2.51	1.64	3.55	0.25	2.07	1.83	1.17	**23.38**
1872	0.64	1.15	2.43	2.77	6.04	4.28	4.59	0.93	3.38	0.55	2.01	1.70	30.47
1873	3.53	1.52	2.10	**6.88**	5.73	6.68	5.96	**0.07**	3.02	3.27	1.64	5.10	45.50
1874	3.14	3.66	4.36	3.44	3.70	2.00	5.71	4.70	2.30	1.09	2.32	1.46	37.38
1875	0.54	2.59	4.08	2.53	5.48	**10.84**	**9.50**	2.66	0.24	1.23	0.89	2.42	43.00
1876	4.75	2.86	6.90	2.35	3.13	6.43	5.90	5.03	7.63	1.66	1.74	**0.18**	48.46
1877	1.24	0.88	3.41	3.03	3.11	8.69	2.88	2.61	3.56	4.92	3.76	3.34	41.43
1878	2.36	1.69	2.79	6.74	4.63	2.40	3.92	4.75	3.42	3.27	1.38	3.48	40.83
1879	1.64	1.48	1.92	2.31	**0.95**	4.04	1.97	2.23	1.34	0.68	4.30	2.84	25.70
1880	3.83	2.65	2.51	3.31	3.44	2.56	5.17	1.53	3.10	2.09	2.67	1.80	34.66
1881	0.49	4.16	1.95	3.14	3.96	2.74	2.13	0.31	3.14	7.21	**6.74**	1.40	37.37
1882	2.80	**8.94**	3.49	3.58	4.55	4.53	3.84	2.20	1.73	2.44	3.24	1.81	43.15
1883	0.94	5.88	2.29	3.31	2.89	5.04	4.31	3.34	**0.01**	6.60	3.71	1.78	40.10
1884	0.79	4.43	3.00	4.15	2.68	4.52	2.86	1.21	6.04	2.48	2.30	**6.18**	40.64
1885	3.26	0.87	**0.40**	4.84	2.80	7.68	2.58	2.96	8.98	**7.51**	1.68	2.03	45.59
1886	3.11	1.71	3.04	2.10	7.84	7.09	0.55	2.44	**9.60**	0.85	3.36	2.65	44.34
1887	0.65	3.68	3.54	4.36	5.27	2.54	2.74	1.14	2.47	0.76	4.61	3.54	35.30
1888	2.15	2.39	3.79	1.88	3.81	8.09	2.09	**6.66**	1.31	2.59	4.40	2.01	41.17
1889	3.04	4.78	1.62	1.68	3.80	4.72	2.02	0.85	3.54	1.65	4.43	1.03	33.16
1890	**7.47**	2.86	5.99	4.05	5.81	3.18	**0.37**	2.43	1.80	0.86	1.55	1.32	37.69
1891	1.35	2.95	22.9	2.29	2.73	5.97	1.50	2.75	1.43	0.65	5.30	1.32	30.53
1892	1.52	4.89	1.92	7.60	7.87	2.73	4.64	1.75	1.59	1.66	3.46	1.99	41.62
1893	**0.33**	2.98	5.10	**10.84**	5.42	3.49	2.49	0.65	3.69	1.66	1.36	1.32	39.33
1894	2.56	2.88	2.69	2.68	3.61	**1.12**	1.35	1.66	3.11	1.56	1.49	2.73	27.44
1895	1.65	**0.43**	2.82	**0.46**	3.16	2.46	7.26	2.08	2.01	**0.23**	3.98	4.66	31.20
1896	1.43	2.81	2.03	2.43	**9.12**	4.57	4.67	2.12	2.42	1.20	3.70	1.05	37.55
1897	3.75	2.67	**8.25**	4.66	1.59	5.32	3.23	0.66	0.09	0.31	6.21	3.43	40.17
1898	4.53	1.71	7.73	3.85	8.55	3.85	7.44	0.87	3.23	4.34	2.07	1.03	**49.20**
1899	1.66	3.40	3.96	1.98	6.32	2.32	4.54	2.77	1.27	2.89	1.95	1.55	34.61
1900	0.65	5.09	1.45	1.83	4.47	2.62	3.85	1.30	2.68	2.07	3.10	0.40	29.51
1901	1.12	1.86	2.94	2.35	2.69	3.92	1.47	0.76	0.64	2.12	1.21	3.72	24.80
1902	1.18	0.83	4.50	2.49	3.04	7.86	2.34	5.20	1.98	2.00	3.20	3.81	38.43
1903	1.76	3.14	3.20	2.79	2.08	5.71	2.68	6.16	3.06	1.37	0.61	1.25	33.81
1904	3.15	0.84	7.87	3.25	2.88	4.64	3.09	2.62	2.97	0.50	**0.54**	1.36	33.71
1905	2.47	1.12	2.35	2.32	4.67	2.72	4.42	2.58	5.56	6.64	1.63	2.06	38.54
1906	3.57	2.92	4.53	1.98	2.61	2.80	0.98	3.72	4.40	1.25	4.67	2.09	35.52
1907	7.35	1.12	2.39	3.65	5.57	4.96	3.32	4.36	1.57	3.15	1.89	2.06	41.39

EXTREMES.*

TABLE C.

Month	Temperature						Precipitation			Wind			
	Max.	Year	Day	Min.	Year	Day	24hr. Max.	Year	Day	Max. Vel.	Dir.	Year	Day
January....	74	1890	11	—22	1884	5	3.57	1890	1	66	SW	1898	25
February...	78	1890	4	—18	1905	13	4.44	1882	19–20	62	SW	1904	7
March.....	90	1907	21	3	1899	7	3.58	1904	24–25	60	W	‡1880	21
April.....	91	1899	29	22	1875	17	3.97	1878	22–23	60	SW	1904	8
May	94	1875	31	32	1872	2	3.39	1886	14–15	80	NW	1896	27
June.....	102	1901	29	44	1894	6	4.80	1902	28	61	W	1882	17
July	107	1901	24	55	1891	9	5.08	1898	7–8	58	W	1900	24
August.....	106	1881	12	52	1887	24	3.04	1878	9–10	72	NW	1878	4
September ..	102	†1881	5	37	1899	30	3.47	1885	3–4	48	SW	‡1890	11
October	91	1897	5	24	1887	25	3.26	1905	17–18	54	S	1887	23
November..	82	1879	13	5	1872	29	2.99	1881	17–18	58	SW	1898	21
December...	74	1875	31	—14	1872	24	2.61	1873	2–3	60	NW	1885	4

* U. S. D. A. Weather Bureau. Annual Meteorological Summary, St. Louis, 1907.—Precipitation is recorded in inches.—Greatest and least precipitation in bold-face type.—Wind-velocity in miles per hour.—† Also 1899 on the 5th. ‡ And other dates.

From the temperature table given (A) the following data have been calculated. The mean covers the period from 1874 to 1907. The seasonal division here made is: spring, March, April, May; summer, June, July, August; autumn, September, October, November; winter, December, January, February.

TABLE D.

Seasonal Mean				Annual Mean	Extremes	
Winter	Spring	Summer	Autumn		Maximum	Minimum
33.94	55.55	77.18	52.67	56.47	107	–22

AVERAGE AND EXTREME TEMPERATURE.

A comparison of normal temperature and precipitation for St. Louis, given by Fippin and Drake,* is reproduced as Table E.

TABLE E.

Month	Temperature	Precipitation	Month	Temperature	Precipitation
January	30.5	2.18	July	78.8	3.76
February	35.1	2.78	August	76.8	3.50
March	43.1	3.49	September	69.4	3.12
April	56.2	3.79	October	57.5	2.89
May	65.8	4.58	November	43.6	3.10
June	75.2	5.08	December	35.6	2.81

NORMAL TEMPERATURE AND PRECIPITATION.

It is almost unnecessary to state that figures obtained for various stations in our section show marked differences. Even where conditions are fairly uniform the differences are striking. This is well illustrated by Table F, containing figures taken from a paper by Nipher.†

* Fippin, E. O. and J. A. Drake. Soil Survey of the O'Fallon Area, Missouri-Illinois. Rept. U. S. D. A. Bureau of Soils. **6 :** 817. 1904.

† Nipher, F. E. Report on Missouri Rainfall, with Averages for ten Years ending December, 1887. Trans. Acad. Sci. St. Louis. **5:** 383. 1889.

TABLE F.

Locality*	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year
Station 1...	2.80	8.94	3.49	3.58	4.55	4.53	3.84	2.20	1.73	2.44	3.24	1.81	43.15
Station 2...	3.68	7.21	3.39	4.30	4.36	4.78	3.56	2.53	1.46	2.33	3.16	1.75	42.51
Station 3...	2.34	6.99	3.57	3.47	4.22	4.57	1.10	2.07	1.38	3.21	2.77	1.49	37.18
Station 4...	2.80	6.96	2.14	3.17	4.89	3.80	4.30	3.52	1.71	2.42	4.00	1.16	40.87
Station 5...	2.87	6.54	3.29	2.16	4.29	4.94	4.84	2.67	2.73	3.55	3.04	1.84	42.76

RAINFALL IN OR NEAR ST. LOUIS, 1882.

An excellent exposition of the relations existing between soils and plant growth on the one hand and temperature on the other, as well as of the influence of precipitation, is given by Hilgard.† Unfortunately there are no records available for our different habitats. Yet data obtained from two points, the one to the northwest, the other to the southeast of our territory, do not show a very great difference, as is exemplified by Table G.

TABLE G.

Month	Temperature			Rainfall		
	St. Louis	Mascoutah	Diff.	St. Louis	Mascoutah	Diff.
April	56.1	53.6	+2.5	3.52	3.94	—.42
May	66.5	64.0	+2.5	4.24	4.67	—.43
June	75.1	74.0	+1.1	4.47	4.22	+.25
July	78.7	77.9	+ .8	3.21	3.09	+.12
Aug.	77.2	75.7	+1.5	2.66	2.78	—.12
Sept.	70.0	69.4	+ .6	2.91	3.44	—.53
Oct.	58.4	56.6	+1.8	2.41	2.21	+.20
Nov.	43.4	42.9	+ .5	2.88	3.26	—.38
Dec.	35.5	34.5	+1.0	2.23	2.38	—.15

ST. LOUIS, MO., AND MASCOUTAH, ILL., 1907.‡

* Station 1, St. Louis Signal Service. Gauge on the roof of the St. Louis Life Insurance Building, 6th and Locust Sts.—Station 2, Washington University. Gauge 6 feet above the ground in the rear yard of a dwelling on the S. E. cor., 18th St. and Washington Ave.—Station 3, St. Louis Waterworks. Top of gauge 16 inches above the ground with no tree or building within 75 yards.—Station 4, Jefferson Barracks, St. Louis Co., Mo.—Station 5, Mascoutah, St. Clair Co., Ill. Gauge 3 feet above ground.

† Hilgard, E. Soils. 289, 305, 310. New York. 1908.

‡ Compiled at the St. Louis Weather Bureau from data in U. S. D. A. Weather Bureau. Climatological Report, Illinois Section. **12**[13]. 1907.

The main point to be remembered in judging temperature conditions in the field from data obtained in the city is that true extremes are seldom obtained in the latter location on account of the lesser radiation of brick structures. Both in winter and summer, during the day as well as at night, the extremes of temperature are less in the cities than in the field. This is largely due to the lack of protection from wind of stations in the field.

If the differences to be observed in the temperature of various stations in the territory having similar aspect are so slight as to be negligible, this is not so where the formations are of a different nature. Measurements at various stations have shown a variation of from 2 to 10° C. at approximately the same hour and on the same date. In summer the temperature of the oak woods is at least 4° C. lower than that of the field, while at night it is as much higher. This figure is based on a limited number of observations made near Jefferson Barracks during 1907. The need of automatic instruments for the registration of temperatures, etc., is, however, indicated. This, in the vicinity of a large city, appears to be hopeless, even the most simple and seemingly well-hidden instruments being subject to vandalism.

In a former paper* attention was called to the protective action of forests, preventing extremes of temperature and moisture, as shown by Ebermayer.† Comparative observations made in Europe, in a beech forest situated at an altitude of 400 m., gave the following results:

TABLE H.

SOIL TEMPERATURES.

Temperature	In the wood		In the open	
	Max.	Min.	Max.	Min.
At surface	21.5	.....	28.6	.....
One half foot below surface	18.4	—2.5	24.5	—4.6

* The Germination of *Hydrastis canadensis*. Rept. Mo. Bot. Gard. **18**:85. 1907.

† Ebermayer, E. Die physikalischen Einwirkungen des Waldes auf Luft und Boden, etc. **1.** Aschaffenburg. 1873.—Temperatures in degrees of the Centigrade scale.

From this it will be seen that at the surface the highest temperature was 7.1° C. higher in the open than in the wood, while half a foot below the surface a difference of 6.1° C. was found. It will also be noted that in winter the temperature of the soil half a foot below the surface was considerably higher in the wood than in the open.

Not only are plants growing in woods protected from extreme temperatures, but they also enjoy a fairly uniform degree of humidity of the soil. Another factor which frequently plays a great part in the presence of plants in certain localities is the air current. This is true especially where occur ravines such as we find at Cliff Cave. Just how these air currents affect plant growth will be shown later.

Another important factor, not to be lost sight of because of its intimate relation to plant distribution, is the ratio existing between evaporation and rainfall, as shown by Schimper.* In the section studied, the rainfall is between 60 and 80% of the evaporation.† Naturally the nature of the plant growth, etc., modifies this ratio to a great extent, as shown experimentally by Livingston,‡ by means of his simple and ingenious atmometer.

A seeming gradual decrease of rainfall in this section,§ may have exerted a great and lasting influence upon the local flora, though records by means of which such changes could be followed are unfortunately not available.

Important climatological influences upon the flora are exerted by the daily extremes of temperature, especially those occurring during the earlier part of the year, which act not only upon the plants themselves but also upon the limestone rock. Alternate periods of freezing and thawing can be supported by the winter-rosettes of the hardiest plants only. Differences of 30° F. are not infrequent, and

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* Schimper, A. F. W. Pflanzengeographie. 174. Jena. 1898.

† Transeau, E. N. Forest Centers of Eastern America. Am. Nat. **39**: 875. 1905.

‡ Livingston, B. E. Evaporation and Plant Development. The Plant World. **10**: 269. Dec. 1907.—Evaporation and Plant Habitats. The Plant World. **11**: 1. Jan. 1908.

§ Trelease, W. Thirteenth Annual Report of the Director. Rept. Mo. Bot. Gard. **13**: 16. 1902.

since the minimum is ordinarily several degrees below the freezing point, these factors likewise assist to some extent in the disintegration of the rock surface, especially since the limestone is porous and absorbs a considerable amount of water. However, the St. Louis limestone appears to be able to withstand climatic influences so well that locally it is largely used as a building-stone. While there is a considerable variation in its composition, on the whole it may be said that laboratory tests have shown that the crushing strength of samples subjected to freezing was not seriously diminished.* Hence changes in temperature probably do not greatly affect the rock surface. On the other hand, they serve to pry apart, at the fissure joints, those blocks of limestone which are situated near the surface.

Geology.

But few geological or paleontological papers deal exclusively with the region or part of the region under discussion and the various publications treating of those parts of Illinois and Missouri, situated along the banks of the Mississippi in the vicinity of St. Louis, must be taken into consideration.

As far as Missouri is concerned, previous to the first State Geological Survey, none but the most general features had been recognized, the main interest being centered on the metal, ore and coal producing regions. A summary of such geological work as had been done, is given by Swallow,† with whose appointment as State Geologist was inaugurated a new era, during which were studied not only the different geological formations, but also the fossils which they contained, something which up to that time had been practically neglected.

As far as the vicinity of St. Louis is concerned, it was especially the work of Dr. B. F. Shumard which contributed largely to a detailed and accurate knowledge of its geology and paleontology. Especially from the standpoint of the latter science the field is exceedingly rich and attractive, so

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* Buckley, E. R., and H. A. Buehler. The Quarrying Industries of Missouri. Mo. Bureau Geol. and Mines. 2 ser. **2.** 1904.

† Swallow, C. G. First and Second Annual Report of the Geological Survey of Missouri. Appendix A. 1855.

that at the present time its contents are well studied. Among the 800 or more publications mentioned, in 1890, by Sampson * as dealing with the geological problems of Missouri, a large percentage treat of paleontology only. A bibliography, more ample and arranged according to a different system, is given by Keyes,† since the publication of which a number of others, dealing with St. Louis county, have appeared. They are to be found chiefly among the publications of the U. S. Geological Survey and in the Proceedings of the Academy of Science of St. Louis.

For the geology of that part of Illinois considered in the present paper, the publications of the Geological Survey of Illinois and those of the U. S. Geological Survey have been drawn upon for information. Further bibliographic references are given by Weeks.‡

THE MISSOURI SECTION.

In this portion of our territory the Pleistocene, the Carboniferous and the Silurian periods are represented, though not all of them are exposed. Neocene, Eocene, Cretaceous and Jura-Trias are entirely lacking here and in the adjacent territories, both in Missouri and Illinois. The coal measures are found in the Illinois portion of our territory as well as immediately north of the Missouri section, above the mouth of the River des Pères. The latter are a portion of the Illinois coal field.§

An excellent idea of the formations, as occurring in St. Louis county, may be obtained from a general section pub-

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* Sampson, F. A. A Bibliography of the Geology of Missouri. Geological Survey of Missouri. Arthur Winslow, State Geologist. Bulletin **2**: 5. 1890.

† Keyes, C. R. Bibliography of Missouri Geology. Missouri Geological Survey. Charles Keyes, State Geologist. **10**: 219. 1896.

‡ Weeks, F. B. Bibliography of North American Geology, Paleontology, Petrology and Mineralogy for 1892–1900 inclusive. Bull. U. S. Geol. Survey. 188. 1902.—Index to North American Geology, Paleontology, Petrology and Mineralogy for 1892–1900, inclusive. Bull. U. S. Geol. Survey. 189. 1902.

§ Gallaher, Jno. A. Preliminary Report on the structural and economic Geology of Missouri. Missouri Geological Survey. **13**: 167. 1900.

lished by Ladd.* It is understood that as a result of recent investigations by members of the U. S. Geological Survey, this column should be modified to some extent. As it stands at present it is a compilation of the work accomplished in this section along geological lines since its inception by Shumard in 1854 and up to 1890. It was especially the boring of a well at the Insane Asylum at St. Louis, sunk to a depth of nearly 4,000 feet, which threw light upon the rocks which in no place in this vicinity reach the surface.†

Quaternary Deposits.

The most detailed description of the quaternary formation of the Missouri portion of our section is that by Todd.‡

1. Recent Alluvium.—The alluvium deposited by the Mississippi is in part derived from the Missouri River which enters the former about ten miles north of St. Louis. It is mainly composed of sand, with coarser material towards the bottom. On top of the sand we find clay or mixtures of sand and clay. These deposits, which are numerous but variable, both in size and locality, are also the first stages of the sandbar formations. On the west bank of the Mississippi occur wider or narrower bottoms, overflowed at times of flood only. Their subsoil, to a depth of several feet, is a heavy loam laid down by the river. Owing to the growth of tall annuals which during the summer and autumn cover these banks, the loam is soon covered by a thick mat of decaying vegetation forming a rich, black soil. As a result of the nature of the shore south of St. Louis, terrace formations are absent.

2. Loess.—This name is applied to the loamy clay which in layers of varying thickness, sometimes as much as 50 feet, overlies the St. Louis limestone, owing its name to its resemblance to certain sedimentary deposits, thus designated,

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* Ladd, G. E. The Clay, Stone, Lime and Sand Industries of St. Louis City and County. Geological Survey of Missouri. Bull. 3. 1890.

† Broadhead, G. C. On the Well at the Insane Asylum, St. Louis County. Trans. Acad. Sci. St. Louis. **3**: 216. 1878.

‡ Todd, J. E. Formation of the Quaternary Deposits. Missouri Geological Survey. Charles R. Keyes, State Geologist. **10**: 111. 1896.

in the valley of the Rhine. Todd * describes it as follows: "Loess . . . is composed mainly of fine grains of silica some of which attain the size of .2 mm., though the majority are less than .01 mm. These particles are coated, more or less, with oxide of iron and calcic carbonate. The amount of the former gives it the color which in the typical form is usually a light buff. With it is mixed many small grains of clay. The finer ingredients appear to constitute a cement which holds it firmly together so that it usually stands firm like indurated rock, unless softened by moisture." An increase in the amount of oxide of iron increases the intensity of the color of the loess. Its absence is indicated by a gray or even whitish color.

3. Bouldery drift.—This underlies the loess, and covers the surface along the western bank of the Mississippi below St. Louis as far as the mouth of the Meramec, occupying a strip two to five miles wide.† Interesting in this connection is Wheeler's paper, bearing on the occurrence of blue glacial clay or "till" at St. Louis.‡ From this it appears that there exists some doubt as to the glacial origin of the drift above referred to. However, more recent work, as yet unpublished, seems to eliminate such a doubt.

Subcarboniferous System.

The ferruginous sandstone of the Chester group which in other portions of St. Louis county underlies the coal measures and in places attains a thickness of 250 feet, is, in our territory, represented by a thin layer of sandy shale, never more than a few feet in thickness. It directly overlies the St. Louis limestone. The latter is a very hard, fine-grained rock, varying in color from light yellow to light-gray and blue-gray. It is evenly bedded, the strata varying in thickness so as to yield both dimension stone and flagstone. It is interstratified with layers of argillaceous shale. Some of the lime-

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* *loc. cit.*

† Wright, G. F. U. S. Geol. Surv. Bull. **58 :** 72-73. 1890.

‡ Wheeler, H. A. Note on the Glacial Drift in St. Louis. Trans. Acad. Sci. St. Louis. **7 :** 121. 1895.

stone strata are a nearly pure carbonate of lime, in other strata the limestone is mixed with sand. The beds are nearly horizontal, having a slight inclination to the northeast. The first detailed description accessible is that of Engelmann.* It reaches its greatest development on the western shore of the Mississippi between the mouth of the River des Pères and the mouth of the Meramec. It contains many characteristic fossils. The total thickness of the St. Louis limestone is estimated at 250 feet, of which, along the bluff, from 40 to 120 feet are exposed. The entire section is as follows:

Lower Carboniferous...	St. Louis.....	250 ft.
	Keokuk.....	225 ft.
	Burlington.....	200 ft.
	Chouteau.....	65 ft.
Lower Silurian.....		800 ft.

THE MISSISSIPPI RIVER.

The Mississippi River, which in our section closely follows the bluffs on the western side, is of varying depth. Its channel, which for the greater part is situated on the Missouri side, varies in depth from 10 to 58 feet,† and is cut in the alluvial deposit.

The depth of the alluvial deposit is not known with exactitude. Todd says: "At St. Louis there are varying depths from low water to bedrock: at the east end of the Eads bridge it is 95 feet, at the east pier of Merchants' bridge it is 45 feet, in a well at the Tudor Iron Works 79 feet." The bedrock is the St. Louis limestone.

THE ILLINOIS SECTION.

In the Illinois section, the Quaternary, Carboniferous and Silurian systems are recognized.‡ The Quaternary system, quantitatively, in depth as well as in area, is better represented than in the Missouri section.

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* Engelmann, G. Remarks on the St. Louis Limestone. Amer. Journ. Sci. and Arts. 2 ser. **3**: 119. 1847.

† Survey of the Mississippi River, made under the Direction of the Mississippi River Commission. Chart 114.

‡ Worthen, A. H. Geological Survey of Illinois. **1**: 21. 1866.

Quaternary Deposits.

In their deposition and arrangement the Mississippi, which, unlike most rivers in southern Illinois, follows the pre-glacial drainage lines,* played an important part.

1. Recent alluvium.—This is of the same nature as that in St. Louis county, however, it overlies a bed of sediment consisting chiefly of an upper sandy portion and a lower part composed of gravel and pebbles. This is well shown by the boring made during the summer of 1905 in the vicinity of Monk's Mound, Ill., just north of the line dividing St. Clair and Madison counties. Records of the borings, of which samples were placed in the museum of the Academy of Science of St. Louis through the agency of Mr. J. J. Lichter, were published by Bowman† and are here reproduced as Table I. In this table, which was verified by a comparison with the samples just mentioned, certain of the borings which appeared to be identical, have been added together for the purpose of condensing the table.

It is doubtful whether the deposits above referred to are of glacial origin. Bowman,‡ while granting that the ice may have brought down and filled in a portion of the material, believes it more rational to suppose "that the river and tributaries brought in the material from the thick glacial deposits which cross the river higher up and from the bluffs nearby." How rapidly the river is building out the flood plain may be judged by the fact that Cahokia, one mile east of the river, in 1850 was situated on the bank of the river. The tributary streams too carry large burdens, as evidenced by the deposits near French Village, or the instance quoted by Bowman who mentions the fact that the southern outlet to Pittsburg Lake has been largely closed up by bluff sediments of Druit Creek.

2. Loess.—This covers the hills to a greater or less depth, and often reaches a thickness of 60 feet, as at the quarry near

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* Leverett, F. The Water Resources of Illinois. U. S. Geol. Surv. Ann. Rep. **17**^{2} **:** 706. 1895–1896.

† Bowman, I. Water Resources of the East St. Louis District. Ill. State Geol. Surv. Bull. **5 :** 106–107. 1907.

‡ *loc. cit.*

TABLE I.

SECTION.	FEET.	
	Thickness.	Depth.
Dirt	40	40
Gray sand	20	60
Very coarse sand, grains of various rock as if glacial material	10	70
Coarse sand and gravel pebbles of brown and yellow quartzite, greenstone, etc., shells, fragments	80	150
Black clay, almost non-calcareous	55	205
Limestone fragments, may be mixed shale and clay	5	210
Gray, non-calcareous shale	5	215
Light black, clay or shale, non-calcareous	5	220
Same laminated, gray and white	5	225
Gray limestone churned to a very fine sand	5	230
Gray, very siliceous limestone, possibly chert, but looks like sand grains; comes in large fragments	5	235
Very fine white to gray sandstone, almost non-calcareous	65	300
Light colored limestone, churned to very fine sand	5	305
Light sandstone, very fine	10	315
Dense white limestone	45	360
Darker limestone	20	380
Light limestone, dense	30	410
Very ferruginous limestone	10	420
Very ferruginous limestone, cherty	20	440
Dense gray limestone	50	490
Lighter limestone	15	505
Gray limestone	10	515
Darker limestone	10	525
Limestone and chert, very ferruginous	10	535
Limestone less ferruginous	45	580
Limestone less ferruginous, finely powdered	10	590
Limestone less ferruginous, some chert	35	625
Limestone, largely chert, crinoid stems	25	650
Dark gray limestone	20	670
Mostly white chert	10	680
Light colored limestone, often stuck together with light colored clay which may have been largely washed out	38	718
Blue calcareous clay	62	780
Gray cherty limestone	10	790
Nearly all white chert, finely powdered but angular	10	800
Limestone and white chert	10	810
Largely white chert, finely powdered but angular	30	840
Largely white chert, finely powdered but angular	10	850
Largely white chert, as fine as glass sand	20	870
Limestone and white chert	10	880
Largely white chert fragments	15	895
White limestone and white chert	55	950
Largely white chert fragments	15	965
Greenish gray limestone	30	995
Greenish gray limestone, much chert of similar color	20	1,015
Pink calcareous clay	30	1,045

BORINGS NEAR MONK'S MOUND.

TABLE I.—*Continued.*

SECTION.	FEET.	
	Thickness.	Depth.
Limestone white to green and red, crinoid stems	5	1,050
Light green calcareous plastic clay	2	1,052
Light colored dense limestone	18	1,070
Light colored dense limestone, finely churned	5	1,075
Mainly limestone but has Fern Glen fragments, grains.	3	1,078
Finely powdered pink limestone like Fern Glen, large silica grains, round	3	1,081
Finely powdered but more gray limestone fragments	14	1,095
Dark blue clay, slightly calcareous	10	1,105
Blue shale fragments, calcareous	20	1,125
Blue shale fragments, more gritty, non-calcareous	10	1,135
Gray limestone chips	35	1,170
Gray to brownish pink gritty limestone, fragments are almost all pink	25	1,195
Greenish gray limestone fragments	10	1,205
Gray and pink gritty	5	1,210
Gray and pink gritty	3	1,213
Gray and pink gritty, but churned to very fine sand	12	1,225
Gray limestone chips	5	1,230
Gray limestone chips, pink fragments still intermixed	20	1,250
Gray limestone chips, mostly pinkish	5	1,255
Light gray limestone, in sharp chips	5	1,260
Light gray limestone	5	1,265
Light gray limestone, finer sand more rounded	5	1,270
Light gray limestone	5	1,275
Light gray limestone, pyrite noted	5	1,280
Light gray limestone, except pyrite	5	1,285
White limestone ground to coarse sand	10	1,295
White limestone ground to coarse sand	5	1,300
White limestone fragments	15	1,315
White limestone in rounded grains, some gray and appear very siliceous	10	1,325
White limestone, but none of the gray siliceous grains	10	1,335
Greenish gray shale, almost non-calcareous	45	1,380
Dark gray or greenish gray limestone, soft enough to be a calcareous shale	110	1,490
Pinkish white, probably siliceous limestone	20	1,510
Probably siliceous limestone, milk-white	70	1,580
Siliceous chips, large admixture of dark gray slaty grains, non-calcareous	20	1,600
Siliceous chips, large admixture of dark gray slaty grains, non-calcareous	50	1,650
Siliceous chips, the gray disappearing	30	1,680
Gray limestone	20	1,700
Lighter, yellow limestone	30	1,730
Lighter, yellow limestone	25	1,755
Lighter, yellow limestone	20	1,775
Brown gray limestone, churned to fine sand	200	1,975
Siliceous sand, round grains, plainly St. Peters	100	2,075
Siliceous sand, round grains, plainly St. Peters	25	2,100

BORINGS NEAR MONK'S MOUND.

Stolle, but thins out towards the east. Worthen * deems it probable "that it was accumulated when the present valley of the river was occupied by a chain of lakes, the waters of which filled it nearly to the height of the adjacent highlands, and that it was originally spread over the whole surface of the valley. A considerable portion of it was no doubt removed during the drainage of the valley by the gradual elevation of the surface and other portions have been subsequently removed by the action of river currents." Interesting in this connection is the opinion expressed by Hershey.†

3. Bouldery Drift.—The drift originally covered the highlands to a depth of 10 to 50 feet and was accumulated while the whole surface was under water. It consists mainly of yellow and brown clays intermingled with gravel, with here and there an occasional boulder. Till, a blue, plastic clay, ordinarily underlies the deposit, and between the blue and the yellow clays there is sometimes a stratum of sandy material, a few feet in thickness.

While ordinarily the loess is bedded on the drift and the latter overlies the stratified rock, it sometimes occurs that the drift apparently has been removed by currents previous to the deposition of the loess, in which case the latter lies immediately upon the rock.

Carboniferous System.

This, both in Madison and St. Clair counties, comprises the lower portion of the coal measures and the sub-carboniferous limestones. There is here a dip of the limestone which, disappearing just below Alton, reappears about Pittsburg, Ill. These coal measures have a thickness of 300 feet or more. They underlie nearly all the upland in St. Clair and Madison counties, but are greatest in the eastern portion, thinning out towards the river bluffs. They are composed of shales, either sandy, calcareous or bituminous, and a few comparatively thin strata of fireclay, limestone and coal. The coal seams vary from 6 inches to 4 feet in thickness. Here

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* *loc. cit.* 298.

† Hershey, O. H. The Loess Formation of the Mississippi Valley. Science N. S. **5**: 768. 1897.

and there the first workable coal is found comparatively near the surface, as at Edwardsville, where the arrangement is as follows:

Loess and drift clay, about	60 ft
Broken shale	2 ft.
Limestone	5 ft.
Coal	2 ft.
Hard, blue, argillaceous limestone alternating with bands of calcareous shale	16 ft.
Coal (Belleville No. 1 c)	6 ft.

In other places the coal lies 250 feet deep. Worthen,* describing the coal measures, says in substance:

The coal measures in St. Clair county comprise a thickness of about 300 feet of the lower part of the coal series, embracing the horizon of five coal seams only two of which appear to be of economic value at the present time. . . The western boundary of the coal measures intersects the river bluffs about two miles below Centerville station . . . and from that south to a point two miles south of the town of Centerville and then with a south easterly trend it crosses the Okaw near Tamaroa. Northward from the point where the boundary line intersects the bluffs, it follows the course of the bluffs in a northeasterly direction to the south line of Madison county, just north of Caseyville. Dip is moderate and in an easterly direction. . . . These beds form a continuous outcrop from their first appearance in the river bluffs about 1½ mile below Centerville station to the north line of the county, about 1½ mile north of Caseyville. . . . Belleville coal seam No. 1 C is the principal one worked. Above this coal there is sometimes a foot or more of bituminous shale but more frequently the coal is directly overlaid by the limestone and also underlaid by limestone. Above the limestone which forms the roof of the Belleville coal we usually find bands of calcareous and sandy shales, varying in thickness from 10 to 20 feet and on the small creek just north of Belleville these shales terminate upward in a bed of light gray clay shale, resembling a fire clay. This clay shale contains fossils . . . and is overlaid by another

* Worthen, *loc. cit.*

limestone 10 to 12 feet thick . . . quarried for building stone. In the river bluffs at the old Pittsburg mines it is only about 4 feet thick.

Referring to the western boundary of the coal measures, mentioned in the passage just quoted, Bowman* points out that "at Granite City the river sediments rest on the massive bed of the Mississippian limestone, while at Monk's Mound and near Peters they rest respectively on a shale and a sandstone which are undoubtedly coal measures strata." He expresses the opinion that the line of contact between the Mississippian and Pennsylvanian formations in the American Bottoms, while not known with exactitude, is probably somewhere between the eastern edge of East St. Louis and Monk's Mound. As has been pointed out previously, it is probable that the Pennsylvanian formation extended across the flood plain of the Mississippi, since "coal measures rocks are found not only in the bluffs from Centerville around to North Alton and in sections of deep wells near Monk's Mound and Peters, but beyond the Mississippi in the City of St. Louis and districts to the west and northwest. This was probably the condition in preglacial times, since geologists are agreed that the river trimmed the present bluff line previous to the glacial epoch."

The subcarboniferous limestone, which in the southern portion of the adjoining county of Randolph is at least 600 feet thick, has thinned out, before reaching the southern part of St. Clair county, to an aggregate of less than 100 feet, and includes only the lower sandstone and a thin bed of limestone. These beds outcrop around the southwest borders of the coal field in St. Clair county, commencing in the river bluffs, about 2 miles below Centerville station. Worthen describes it in substance as follows:

The limestone is a coarse-grained, thin-bedded gray or brown limestone, with partings of argillaceous material and contains numerous characteristic fossils. The entire thickness may be 20 to 30 feet. It is overlaid by the shales and argillaceous limestones of the Coal Measures, inclosing a

* *loc. cit.*

thin coal seam. There is an outlier of this limestone on the south side of the anticlinal axis that intersects the river bluffs just above the Monroe county line. North of this axis we did not find this limestone exposed anywhere in the river bluffs in this county. The lower sandstone of the Chester group underlies the limestone just described and its outcrop is consequently over a belt of country to the south and west of that occupied by the limestone. The St. Louis limestone makes its first appearance in the river bluffs about 3 miles below Centerville station, where it comes up from beneath the sandstones just described, and it forms the main portion of the bluff from this point to the Monroe county line. At the old lime-kilns, 4 miles below Centerville station it forms a mural cliff from 60 to 70 feet high and continues gradually increasing in elevation to Falling Spring where it measures 115 feet in thickness above the level of the Mississippi Bottoms. It presents here its usual characters of a regularly bedded fine-grained limestone, of a light gray color and compact structure. The beds vary in thickness from 3 inches to 2 feet or more. The upper portion of the mass is a very pure carbonate of lime and appears to be as well adapted to the manufacture of quicklime here as it is at St. Louis and Alton. As we approach the Monroe county line the beds continue to rise and the brown magnesian and semi-oölitic limestones that constitute the lower division of this group are elevated above the surface and compose the main portion of the bluff at the anticlinal axis, about 1 mile above the southern line of the county. Immediately below the axis the upper beds of the group again form the entire bluff, and with a reversed dip, at an angle of about 30 degrees, they plunge below the level of the Mississippi Bottom. The uppermost beds of this group are well exposed in the vicinity of Lark's quarries, about 4 miles from the Centerville station. At this locality the upper layers of the limestone are quite massive and afford solid blocks of limestone from two and one-half to three feet thick. . . . .
At the old lime-kilns, above Falling Spring, we obtained some characteristic fossils. . . . This limestone outcrops only over a very limited area in the southwest corner

of the county, probably not more than one-half of a single township. It is probable that the upper beds of the Keokuk group are elevated above the surface at the axis above referred to but we met with no exposure of them.

Soil.

The first report on the soils of Missouri was that of Swallow* in which those of St. Louis county received but brief mention. The statement is made that a part of St. Louis county possesses a very superior soil and from what follows is gathered that reference is made to "the valley west of the city and in the Florissant." The soil of the bluffs appears to be inferior to this.

The upland portion of that part of our territory situated in Missouri may be classed under two heads, the more elevated portion where the soil directly overlies the limestone, and the less elevated portion, where the soil is formed on and by the upper portion of the loess which covers the limestone to a considerable depth.

As far as the latter portion is concerned, the soil here is a typical loess soil which in its upper layers contains varying amounts of humus, the latter depending on the ground cover (wood, prairie) and the slope. With the exception of a second paper by Swallow†, nothing of importance on this subject was published until the appearance of Schweitzer's paper.‡ Since the experiments with and the analysis of the soil represent "a typical Missouri soil, made of what professor Swallow has called the Bluff formation," they may be made to apply in a general way to our section. The soil in question rested on a limestone foundation and was at least 12 feet deep. Analyses of four samples of soil, taken from the publication just mentioned, follow. Soil samples nos. 1, 2 and 3 each consisted of topsoil (*a*), taken to a depth of

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* Swallow, G. C. Geological Report of the Country along the Line of the south-western Branch of the Pacific Railroad, State of Missouri. St. Louis. 1859.

† Report of the Board of Agriculture of Missouri. 1881.

‡ Schweitzer, P. Soil, Weather, Field Trials with Corn. Missouri Agric. Coll. Exp. Sta. Bull. 5. 1889.

TABLE J.

AIR DRIED SOILS.

	1.a.	1.b.	2.a.	2.b.	3.a.	3.b.	4.
Water at 100° C	1.82	2.92	2.44	2.83	2.31	2.32	4.60
Nitrogen—total	0.14	0.06	0.13	0.06	0.13	0.07	0.02
Carbon—total	1.63	0.80	1.57	0.81	1.67	0.68	0.44
Loss by ignition	6.97	7.47	6.92	6.78	7.18	6.86	6.56
Silica	77.82	74.09	77.20	74.04	77.76	75.36	70.21
Alumina	8.93	10.62	8.02	10.74	8.47	10.10	12.91
Oxide of iron	3.05	4.19	2.73	3.44	3.24	4.72	6.24
Lime	0.63	0.55	0.63	0.59	0.47	0.42	0.62
Magnesia	0.44	0.38	0.40	0.45	0.29	0.21	0.34
Potassa	1.32	1.23	2.54	2.57	1.17	1.13	1.38
Soda	1.59	1.51	2.05	1.99	1.45	1.45	1.72
Phosphoric acid	0.08	0.09	0.07	0.07	0.06	0.06	0.06
Total	100.29	100.13	100.56	100.67	100.09	100.31	100.04

TABLE K.

	1.a.	1.b.	2.a.	2.b.	3.a.	3.b.	4.
Silica	83.06	80.06	82.91	79.39	83.77	80.89	75.13
Alumina	9.60	11.48	8.61	11.51	9.13	10.84	13.81
Oxide of iron	3.28	4.53	2.93	3.69	3.49	5.07	6.68
Lime	0.68	0.59	0.67	0.63	0.51	0.45	0.66
Magnesia	0.48	0.41	0.43	0.48	0.31	0.23	0.37
Potassa	1.42	1.33	2.73	2.75	1.26	1.21	1.48
Soda	1.71	1.63	2.21	2.13	1.56	1.56	1.84
Phosphoric acid	0.09	0.10	0.07	0.08	0.07	0.06	0.07
	100.32	100.13	100.56	100.66	100.10	100.31	100.04
Insoluble in acid	94.73	92.41	95.72	96.10	95.69	96.61	94.34

Portion soluble in muriatic acid.

Alumina	2.44	3.57	1.74	1.55	0.80	0.57	2.53
Oxide of iron	1.95	3.04	1.90	2.00	2.61	2.23	2.59
Lime	0.13	0.13	0.39	0.18	0.13	0.15	0.11
Magnesia	0.25	0.24	0.24	0.19	0.19	0.15	0.02
	99.50	99.39	99.99	99.97	99.42	99.71	99.59
Alkalies dissolved	0.82	0.74	0.57	0.69	0.68	0.60	0.45

IGNITED SOILS.

about 10 inches, and of subsoil (*b*), taken to a depth of 8 inches below the topsoil. The sample marked 4 was obtained from a depth of about three feet, and is a stiff and plastic clay, such as is occasionally found in the Bluff formation in pockets or layers, anywhere and at any depth.

"For the sake of comparison with other soils a second table is calculated for perfectly dry material, and in addition some data given, which are derived from treating the ignited soils with muriatic acid and partially analyzing the solution.

"The composition of these soils is so nearly uniform as to warrant the conclusion that the results of field experiments made upon them cannot be influenced by any supposed difference in their make up."

In the more elevated portions of our territory, such as we find in the vicinity of Jefferson Barracks and from there south to the Meramec, the soil in various places is formed directly upon and from the sedimentary rocks, though here and there seem to be some indications of the presence of drift. In such cases the residual soil is of a rich nature, though the St. Louis limestone, as indicated above, is of a rather pure character. It contains a large amount of black humus but has no great depth, varying in thickness from 1 to 12 inches on the hills and plains. Where the plains are covered by timber, the thickness of the soil layer is somewhat greater than in the open. Immediately below the soil is a layer of slightly disintegrated, much broken up limestone,* through which the roots of the plants penetrate, afterwards to find their way through the fissures of the deeper limestone layers.

The wooded slopes of the upland portion are covered by an accumulation of colluvial soil mixed with some residual soil and which, of slight depth in the higher parts, increases in thickness with the slope, so that in places it forms a layer

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* The question whether some of this material is not of glacial origin remains to be settled. The writer never found other than limestone fragments the flat surfaces of which bore no striations. It was thought that the breaking up of the limestone had occurred under the influence of the liquid components of the soil, materially assisted by the mechanical action of the roots of various plants.

of from one-half to one foot. Where these slight upland slopes, which nowhere have a large individual area, have been cleared for cultivation, the humus contents soon leach out, forming the unproductive "white lands." As Hilgard* points out, the light color means the scarcity or absence of both humus and ferric hydrate.

At the base of the cliffs is a notable deposit of soil covering, in many places entirely, the talus, this especially where the loess overlies the limestone. Here the soil is continually being added to by the action of the rills and rivulets which not only brought down residual and colluvial soil from the uplands but themselves aided in the decomposition of the underlying talus. Such lower hillsides ordinarily possess a luxuriant vegetation.

The bottoms on the Missouri side, nowhere very wide, have resulted partly from the deposition, by the Mississippi, of a heavy loam mixed with sand, and partly from the deposition of colluvial soil brought down from the uplands. This soil is rich in lime and in the course of time has been covered by a black humus.

The sandy islands of the Mississippi have the same origin as the sandy stretches immediately bordering the Mississippi on the St. Clair county side and which frequently occur farther inland, the remains of a former river bank, of which we find so striking an example at Cahokia and which, because of the xerophytic character of their ground cover, are readily recognized. In some places on these islands there are large accumulations of clay.

Back of the stretches of sand lies an area the soil of which is composed of heavy loam. It is made up of a mixture of old river deposits covered by the matter deposited by swamps as well as by loess carried down from the bluffs. Its soil is highly calcareous, sharply contrasting with that of the sandy stretches. It is the Yazoo loam† typical of the Mississippi bottoms and highly productive.

The soil at the bottom of the bluffs is partly residual, re-

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* Hilgard, E. Soils. 285. New York. 1907.

† Fippin, E. O., and J. A. Drake. Soil Survey of the O'Fallon Area, Missouri-Illinois. Rept. U. S. D. A., Bureau of Soils. **6**: 815. 1904.

sulting from the decomposition of the limestone under the influence of vegetation and the elements, and partly colluvial, large amounts of loess being carried down.* Not everywhere along the Illinois bluffs are the conditions the same, as will be shown later. From Stolle southward, the soil partakes far less of the loess character than it does immediately north of this. This is intimately associated with the physiography of the region and the interrelation existing between the course of the river in preglacial times and the position of the Pennsylvanian series.

The plateau back of the bluff is covered with a thick layer of loess, containing much lime and iron. The advantages of such a dark soil over a lighter colored one are pointed out by Hilgard.†

Worthen,‡ who was the first geologist to deal with the soil of Illinois, gives the following description of the upland soils:

"The Quaternary deposits, which include the alluvium, loess and drift, are of the greatest economical importance, because the soil is everywhere based upon one or other of these subdivisions, and owes its peculiar features to the character of the strata on which it rests, and from which its organic matters have been derived. All soils consist mainly of the pulverized remains of pre-existing rocks and their fertility depends as much upon the mechanical condition of the material as upon its chemical composition. The conditions under which the drift clays were accumulated were such as to reduce the various rocks from which the material was derived to the condition of a fine sediment that was deposited at the end of that period in the form of a finely pulverized clay, intermingled with silica in the form of sand, magnesia and lime, in such proportions as to form a soil of inexhaustible fertility, under a judicious system of cultivation. To these mineral ingredients have since been added the organic matter derived from the successive growths of animal and vegetable life, that have from year to year matured, and decayed upon the surface, all of which have entered into and

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* Bowman. *ibid.* 53.

† Soils. 285.

‡ Worthen, A. H. Geol. Surv. Illinois. **1**: 315. 1866.

gone to make up, the soil in its present condition. This organic matter has furnished the carbonaceous material to which the black color of the soil is mainly due, and the phosphates, the ammonia and other animal substances which have added greatly to its productive qualities.

"The presence of these deposits over nearly the entire surface of the State, gives that uniform character to the soil which forms so marked a feature in its surface geology and makes it one of the finest agricultural regions on the face of the globe. The soils based upon the loess contain a smaller amount of alumina and a larger percent of silica than the ordinary drift soils, and from the porous nature of the subsoil it absorbs water freely, and withstands the extremes of both wet and dry seasons much better than the ordinary clay soils. The calcareous and marly portions of the loess may be used to advantage as a fertilizer on sour and wet clay soils."

Physiography.

The entire section under consideration formed at one time part of an extensive peneplain, the result of a former cycle of erosion at a time when the land stood lower than it does now. As pointed out by Marbut,* it could be reconstructed at the present day by filling up the valleys. This author further points out that by comparison of the stage of development of this peneplain with that reached by another, the geological age of which can be decided by tracing it to its shoreline and determining the age of the rocks which lie upon it or which were deposited just before the uprising, the geological age of the Missouri peneplain can be arrived at. A comparison with the Appalachian region places the completion of the Missouri peneplain not earlier than middle or late Tertiary time. During the glacial period and subsequent to it this plateau underwent first the changes due to the presence of a large and rapidly moving body of water streaming southeastward and carrying with it a large amount of detritus. As the result a valley was scooped out which later was par-

* Marbut, C. F. Physical Features of Missouri. Missouri Geological Survey. **10**: 24. 1896.

tially filled. The alluvial valley of the Mississippi, near St. Louis, varies in width from four to eight miles, and at no point are its waters circumscribed by the approach of limestone bluffs on either side, though at some places on the Missouri shore the bluffs almost overhang the river.

The river valley during a period when it was covered by extensive, slowly moving, bodies of water, was overlaid by loess. This, occurring after the glacial period, as shown by the drift deposits which in places underlie the loess, was followed by a general uplifting, after which it became subjected to the influences which continue to the present day. The plateau, where not protected by vegetation, was partially denuded from loess, and this, with such soil as might have been formed, carried down the slopes. Smaller streams, finding their origin in precipitation or in local springs, further served to furrow the upper plateau. While on the Missouri side evidences of such action are not so patent to the eye, it is different where the Illinois section is concerned. Here broad, fan-shaped slopes border the hills. This difference is in part due to the geological formation and in part to the fact that the Mississippi in later times hugged the Missouri shore.

The Missouri plateau lies at from 500 to 600 feet above sea-level. It is of a rolling nature, numerous smaller valleys intersecting the land. Here and there are found points of greater elevation than that of the surrounding country, but these are usually of circumscribed area. The surface is partly wooded, partly open and covered by herbaceous growth, grasses forming the major portion. Such prairies, limited in extent and always surrounded by woodland, are always found where the surface is flat or nearly so. A feature common to the woodland and the prairie is the sinkhole. Sinkholes, which take the form of vast funnels, with a diameter of from 10 to 50 yards, originally formed entrances to caves. Frequently, however, they have become partly filled with sediment so that the entrances of the caves have been closed, resulting in the formation of ponds (plate 12,1). James*

* James, E. Account of an Expedition from Pittsburgh to the Rocky Mountains. (Thwaites, R. G. Early Western Travels 1748-1846. **14 :** 111. Cleveland 1905.)

gives an interesting account of the caves existing under these sinkholes, which is quoted here.

"Mr. Say descended into one of these, for the purpose of ascertaining the medium temperature below the surface of the earth. This sink opens at the bottom of a deep ravine. It has two apertures near each other, through which water is admitted, and each large enough to afford passage to the body of a man. Within are two chambers from 6 to 12 feet in breadth and 35 feet long. At the bottom of the second chamber is a pool of water rather difficult of access. In this apartment the mercury stood at 60° F., in a shady part of the ravine about 25 feet below the general surface at 75° F." The fact that the temperature in these caves is so much lower is well demonstrated by the fact that several of the larger caves in the city of St. Louis are used as wine-cellars, as for instance one under a portion of Benton Park, the floor of which is 47 feet below the street level and where reigns a temperature of 45° F., varying but little if at all. Similarly, the largest cave in this vicinity, Cliff Cave or Indian Cave, 13 miles south of St. Louis, was at one time used as a cellar by the Cliff Cave Wine Company.

The principal modification of the upland is the ravine, resulting from erosion by perennial streams. It is an open question whether several of these ravines were not formed, in part at least, by solution of the limestone by underground streams, followed by a subsidence of the earth's crust. That this happens rather frequently is shown by Nason* and it is very probable that the ravine at Cliff Cave was formed in exactly this manner, followed by erosion by surface streams.

The Missouri plateau, at least south of St. Louis as far as the mouth of the Meramec River, ends abruptly, the limestone cliffs overhanging the river, the stratification of the St. Louis limestone being almost horizontal at this point (plate 15, 1). Thus a bluff is formed which affords plants but a slight foothold especially since the erosion by the river in earlier days left numerous concave surfaces. At the base of these bluffs is a small amount of talus, together with colluvial soil brought

* Nason, F. L. A Report on the Iron Ores of Missouri. Missouri Geological Survey. **2**: 90. 1892.

from the plateau. This permits the growth of numerous shrubs and herbs. Here and there small springs issue from the face of the bluffs. Noticeable is the effect of the small creeks upon the St. Louis limestone where it borders the river. A miniature cañon and numerous small terraces are formed, the limestone apparently being removed according to its stratification (plate 15, 2).

The Mississippi bottoms on the Missouri side are not wide, though in places they extend a mile or more. Especially in early summer they are subject to overflow and the inhabitants are forced to dwell in houseboats, for the same reason that the occupants of the lower portions of the American Bottom elect to build their homes on stilts. The river itself derives its distinguishing features from the Missouri,* such as turbid waters, shifting bars and channels, rapid erosion of alluvial banks and extensive accretions, building up and removing islands, tow-heads and battures with great rapidity (plate 11).

Opposite St. Louis, in St. Clair and Madison counties, lies the most northern portion of the most extensive tract of valley country east of the Mississippi, known as the American Bottom (plate 11). Extending from the mouth of the Kaskaskia river to the Piasa hills, four miles above the mouth of the Missouri, it occupies a strip some 80 miles long with an average width of 4 miles. It represents older as well as more recent river deposit. This, in our section, is in places covered by the rich mud of the Missouri combined with a large amount of vegetable matter brought down by the Mississippi. Close to the river its level is but slightly elevated above that of the latter; farther inland its surface rises several feet. Where the land is low and mainly consists of clay it constitutes what is known as the "wet bottom," other, higher places, where the soil is sandy and which largely lack the recent river deposit, are designated as "dry bottom." The latter is met with on the west side of Horseshoe Lake and in the vicinity of Cahokia. Here and there woods

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* Simpson. Rep. U. S. Engineers. 2^2 : 472. 1875. See Todd, J. E. Formation of Quaternary Deposits. Missouri Geological Survey. **10** : 192. 1896.

occupy the land and formerly did so to a greater extent, but at the present time they have largely been cleared away. As is to be expected, sloughs everywhere encroach upon the land-surface, and swamps, the result of slowly draining lakes, are plentiful. Both in the lower part of the American Bottom and close to the bluffs are a number of lakes which receive the water from the numerous creeks descending from the Illinois plateau.* The lakes of the American Bottom (plate 20) may be readily interpreted as being parts of the old bed of the river, isolated through a series of cut-offs. The origin of such lakes, which are typical of the swamps of all gulf rivers but especially of the Mississippi, lies in the winding course of rivers through their flood plains. As pointed out by Marbut† these windings or *meanders* are primarily caused by some obstruction which deflects the current against one of the banks, resulting in the excavation of this bank and deposition on the other. This action causes a slight bend of the river bed. Since the process continues there finally comes about, through deposition on the inner curve and excavation of the outer curve, a deep bend, known as an "ox-bow." The size and length of existence of these ox-bows is determined by various factors, among which the greater length of the stream, and consequent lower gradient and decreased velocity, play important parts. In a meander of great length the difference in water level on opposite sides of the narrow neck will be appreciable and result in the cutting of a small ravine backward from the lower side. This ravine, in times of flood, becomes enlarged and soon forms a new channel for the entire river, forming a cut-off. It may be noted that for each river there appears to be an average width of meander before the cut-off is made. This width, for the Mississippi, is about 6 miles, but is sometimes exceeded, as at New Madrid. However, it seems but

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* For the hydrography see Bowman, I. Water Resources of the East St. Louis District. Ill. State Geol. Surv. Bull. 5. 1907; and Helm, E. G. The Levee and Drainage Problems of the American Bottoms. Journ. Assoc. Eng. Soc. **35**: 99. Sept. 1905.

† Marbut, C. F. The Physical Features of Missouri. Missouri Geological Survey. **10**: 95. 1896.

reasonable to suppose that in earlier days when the volume of water carried by the river was greater, and the material coarser (the transporting power of a current varies as the 6th power of the velocity), and erosion easier (Marbut, p. 95) the size of the ox-bows was correspondingly greater. Under this assumption we can interpret the lakes of the American Bottom opposite St. Louis as the results of a single cut-off. A comparison of the St. Louis sheets of the U. S. Geological Survey of November, 1893, and April, 1904, shows the probable existence at one time of an ox-bow fully 12 miles across. Thus the most northern part of the cut-off is formed by Horseshoe Lake; Spring Lake and Grand Marais Lake * form the middle portion, while Cahokia Lake forms the south bend. In the years which elapsed between the surveys for the two maps (1888-1903), great changes took place, especially as far as the outlines of the lakes are concerned. The 1904 map shows that their area has been greatly reduced. Horseshoe Lake has retreated from its former western boundary; Indian Lake has become a mere swamp, and Spring Lake occupies now but about one-twentieth of its original surface, limited to the most eastern portion, the remainder being swamp. All connection with Pittsburg Lake has been lost. Pittsburg Lake remains practically as it was except that here and there it has retreated and portions of it have been diked. Of Cahokia Lake but a small part of the northeastern portion remains as open water, and for the greater part is a mere swamp through which flows Prairie du Pont Creek.

Striking features of the American Bottoms are a number of elevations, known as "Indian Mounds," on which subject it is of interest to quote Worthen† at length.

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* Designated Pittsburg Lake in the 1904 map. This is the name now generally given to this lake, the old name being occasionally used by the older of the descendants of French settlers. It may be noted here that a portion of the lake, immediately adjoining the bluff, separated from the main body of water by the bridge of the Illinois and St. Louis railroad and divided into two portions by the bridge of the St. Louis, Alton and Terre Haute railroad, is generally known as Bluff Lake. This name, however, properly belongs to the lake immediately south of Falling Spring.

† Worthen, A. H. Geol. Surv. Ill. **1**: 314. 1866.

"A considerable portion of this bottom is below the high water level of the Mississippi, and is therefore subject to periodical inundations from the annual overflow of the river, while other portions are above high water mark and owe their origin to some other cause than the existing river. It seems probable indeed that a considerable portion of the area now comprised in this bottom was originally occupied by deposits of drift clay and loess, that were deposited after the valley was scooped out of the sub-carboniferous limestones, filling the valley to the height of 50-60 feet above its present level, and were in part removed by subsequent erosion during the period of elevation and drainage that succeeded the drift epoch. In proof of this there are many elevations scattered over the surface of this bottom, locally known as "mounds," the formation of which have generally been referred to human agencies. These elevations vary in height from ten to sixty feet or more above the level of the surrounding bottom and when carefully examined are found to consist of drift clay and loess, remaining *in situ* just as they appear along the river bluffs where similar mounds have been formed in the same way by the removal of the surrounding strata by currents of water. We had an opportunity of seeing a good section of the large mound in the upper part of the city of St. Louis exposed by digging into the upper end of the mound for material to be used in filling adjacent lots. It was found to consist of about fifteen feet of common chocolate brown drift clay at the base, which was overlaid by thirty feet or more of the ash-colored marly sands of the loess, the line of separation between the two deposits remaining as distinct and well defined as they usually are in good artificial sections in the railroad cuts through these deposits.

"Hence we infer that these mounds are not artificial elevations raised by the aboriginal inhabitants of the country, as has been assumed by antiquaries generally, but on the contrary, they are simply outliers of loess and drift, that have remained as originally deposited, while the surrounding contemporaneous strata were swept away by denuding forces. They are not found to occupy any fixed relative position in relation to each other, or to have any regularity of size or

elevation, and hence antiquarians appear to have inferred that they were raised simply to serve as burial places for the dead. But the simple fact that they were used for this purpose by the aborigines, which seems to be the main argument relied on as a proof of their artificial origin, seems to me entirely inadequate to sustain such a conclusion, and they were perhaps only selected by them for this purpose on account of their elevated position, for the same reason that they selected the highest point of a bluff, in preference to any lower point, to serve as the last resting place for the earthly bodies of their relatives and friends. I have very little doubt that many of the so-called Indian Mounds, in this State at least, if carefully examined, would prove to be only natural elevations produced by the causes above named."

The American Bottom is bordered by the Illinois bluffs. Because of the geological formation, these, south of Stolle, are of the same nature as the bluffs on the Missouri side. North of Stolle the bluff disappears and gives place to broad, fan-shaped slopes. The ordinarily flat, sometimes undulating tracts, which compose the Illinois plateau, situated from 500 to 600 feet above sea-level, are divided by narrow strips of woodland bordering the creeks and rivers and are covered by a rich soil. The water table of the country is but little inclined and the streams have but a moderate descent. Owing to this, the decaying vegetable matter is not carried off and the rainwater becomes stagnant, resulting in unhealthful conditions. Sinkholes are frequent. Near the bluffs often occur strips of woodland.

THE FLORA.

Plant Societies.

The plant societies which are here analyzed successively from the table-land on the Missouri side of the Mississippi River, to the table-land on the Illinois side, agree very closely with those indicated by Daniels,* the component species, for the greater part at least, being also identical with those in the region studied, the differences which exist being evident from the following detailed analysis.

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* Daniels, F. P. The Flora of Columbia, Missouri and Vicinity. The University of Missouri Studies. Science Series. **1**[2]. 1907.

Regional Associations.

THE MISSOURI PLATEAU.

The principal feature of the plateau on the Missouri side of the river is the oak forest formation. Though a large portion of this plateau, for agricultural purposes, has been denuded of its tree growth, there still remain comparatively extensive tracts where the flora is hardly, if at all, influenced by human agency. The woods occupy a belt, in places several miles in width, bordering the cliffs on the western shore of the Mississippi (plate 10). The area covered by them is mainly of a rolling character, with here and there flat surfaces varying in extent. These are ordinarily free from tree growth and are covered by grasses and herbs. Where these plains are of a comparatively large extent, as occasionally is the case, there is a corresponding change in the ground cover, resulting in a distinct prairie formation, not differing materially from that found on the Illinois plateau.

Intermediate between the forest formation and the prairie formation is the shrub formation. This, as is characteristic of temperate regions as contrasted with conditions prevailing in the tropics, always forms the transition between the forest and the prairie formation. Naturally, numerous modifications, principally due to physiographical conditions, can be noted. So in the forest formation the flora of the dry hilltops varies from that of the lower slopes. Limestone glades offer a flora distinctly their own, sharply contrasting with that of the well drained, shaded hillsides. Owing to the sheltered conditions, the warmer air currents, the deposition of seeds from the plateau through the agency of wind and water, the uphill movement of the talus flora, and the practically continuous supply of water through underground drainage and various other conditions, those of the ravines which are topographically older are rich in species and combine many of the features of the upland and lowland flora. Hill crests further serve to modify conditions, as do the sinkholes, which may be either dry or wet, dependent upon changes in the earth-crust indicated previously.

Forest formation.

In the deciduous forests which cover the larger portion of the Missouri plateau (plate 10), the oak is dominant. The most abundant as well as the most frequent species is the black oak, *Quercus coccinea tinctoria.* Associated with it are *Q. imbricaria, Q. Muhlenbergii, Q. nigra, Q. rubra* and *Q. Schneckii,* the smaller *Q. stellata* forming an important part of the undergrowth. Interspersed with the oaks are hickories, *Carya alba, C. porcina odorata* and *C. tomentosa.** Other species which go to make up the forest are *Juglans cinerea* and *J. nigra, Ulmus fulva, Sassafras officinale, Acer saccharinum, Fraxinus americana, Morus rubra* and *Diospyros virginiana.* Though the tree stems are placed at a considerable distance from each other, their foliage forms a compact roof, allowing but little light to penetrate. Measurements made during the first days of July, about the noon hour, showed the intensity of the diffused light in the forest to be from 8 to 10% of that of the total daylight, the sky being free from clouds. As a result of the low intensity of the diffused light there occurs but little undergrowth of a shrubby nature, though specimens of *Quercus stellata, Ceanothus americanus, Rhus copallina* and *R. glabra, Prunus serotina, Pyrus coronaria, Cornus asperifolia* and *C. florida, Sambucus canadensis* and *Viburnum prunifolium* as well as of *Diospyros virginiana* are met with. Also as a result of the small amount of light the shrubs do not form thickets here but occur as more or less isolated individuals. The ground cover consists largely of biennials and perennials which develop their root leaves either before the leaves of the deciduous trees have appeared or before they have attained their full development;†

* Illustrated by Trelease in: Juglandaceae of the United States. Rept. Mo. Bot. Gard. **7**: 25. 1896.

† Biennials, as shown by Wiesner in his Der Lichtgenuss der Pflanzen, commence their development during a period of decreasing light intensity, i. e. during the latter part of the year and, after a period of rest, resume growth. Perennials, possessing a store of food material, require less light than do annuals. This explains the predominance, in our woods, of perennials such as *Hydrastis, Sanicula, Spiraea, Arisaema,* etc. In woods many of the annuals have made their appearance before the leaves of the trees are unfolded.

yet nowhere are these plants abundant, though most of them are frequent.*

The spring flora is the most numerous and diversified. Among the Ranunculaceae *Delphinium tricorne* and *Thalictrum purpurascens* are the more important. *Podophyllum peltatum*, the May apple, essentially gregarious, occupies large patches here and there. *Viola palmata* and *V. palmata cucullata* occur with great frequency, as do *Oxalis stricta*, *O. violacea* and *Geum album*, though the latter is never abundant, single plants or plants in twos and threes being found in the shelter of tree trunks. Sometimes *Trifolium procumbens* finds its way into the woods, though it properly belongs on the grassy slopes encountered here and there, where it sometimes takes almost complete possession. *Dodecatheon Meadia* attracts immediate attention on account of its delicate pink blossoms pendent from a slender flower stem, its bright green rosette contrasting sharply with the light brown of the decaying oak-leaves which everywhere cover the ground to a depth of several inches. Other species occurring during the spring in these open woods and readily noted because of the number of individuals are *Potentilla canadensis*, *Spiraea Aruncus*, *Heuchera americana*, *Daucus Carota*, *Sanicula marylandica*, *Thaspium aureum* and *T. aureum trifoliatum*, *Cacalia atriplicifolia*, *Krigia amplexicaulis*, *Senecio aureus*, *Phlox divaricata*, *Triosteum angustifolium* and *T. perfoliatum*, *Blephilia ciliata*, *Brunella vulgaris*, *Sisyrinchium albidum* and *S. anceps*, and *Hypoxis erecta*. *Polygonatum giganteum* and *Smilacina racemosa*, always gregarious, occur with frequency. Several species of *Carex* are found, especially *Carex laxiflora latifolia*, which persists throughout the year. The spring grasses are mainly *Agrostis scabra*, *Eatonia pennsylvanica* and *Melica diffusa*. Other spring plants encountered are *Polemonium reptans*, *Cynoglossum virginicum*, *Physalis subglabrata*, *Pedicularis canadensis* (parasitic on *Achillea Millefolium*), *Pentstemon pubescens*, *Aphyllon uniflorum*, *Cypripedium pubescens*, *Camassia Fraseri*, *Trillium recurvatum* and *T. sessile*, and *Botrychium virginianum*.

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*The terms "frequent" and "abundant" here are used in the sense indicated by Pound and Clements, The Phytogeography of Nebraska. 2 ed. 1900.

During the summer the climbers become evident, *Menispermum canadense* and *Ampelopsis quinquefolia* especially, while long and slender, almost etiolated shoots of *Humulus Lupulus* are frequently met with, as are shoots of *Smilax herbacea* and *S. hispida.* Among the herbaceous plants which during the summer are chiefly in evidence must be mentioned *Anemone virginiana. Cerastium nutans* and *C. viscosum,* already present in spring, persist throughout the summer and autumn. *Oxalis cymosa,* readily distinguished from *O. stricta* by its greater stature, dense pubescence of the stem, its runners, the greater number of flowers in the inflorescence and the failure of the pedicel with the ripening fruit to bend at a sharp angle, makes its appearance during the early summer months. Several Leguminosae occur, chiefly *Amphicarpaea monoica, A. Pitcheri, Desmodium cuspidatum, D. marilandicum* and *D. rotundifolium, Lespedeza reticulata* and *L. violacea.* Here and there the graceful stalks of *Eryngium yuccaefolium,* which occurs in patches, can be seen. *Antennaria plantaginifolia,* now as well as earlier, is in evidence wherever the most adverse conditions prevail. Other Compositae which make their appearance about this time are *Actinomeris squarrosa, Cnicus altissimus, Elephantopus carolinianus, Echinacea purpurea, Helianthus occidentalis, Heliopsis laevis, Lactuca ludoviciana, Prenanthes racemosa,* and *Verbesina helianthoides. Apocynum cannabinum* forms patches here and there. *Asclepias purpurascens* is represented by isolated individuals. Also in evidence are *Echinospermum virginicum, Gerardia tenuifolia, Phryma leptostachya, Monarda fistulosa, Scutellaria versicolor, Phytolacca decandra, Polygonum virginicum, Acalypha virginica* and the omnipresent *Euphorbia Preslii.* Frequent is *Tradescantia virginica. Juncus tenuis* covers the paths. Among the grasses *Asprella Hystrix,* several species of *Muhlenbergia, Panicum filiforme* and *Uniola latifolia* are the principal representatives. Several ferns have made their appearance by this time, especially *Adiantum pedatum, Aspidium acrostichoides* and *Woodsia obtusa. Pteris aquilina* forms large patches.

The approach of fall is heralded by the blooming of numerous Compositae. Of these the more important are, besides

Erechtites hieracifolia, Aster azureus, A. cordifolius and *A. turbinellus, Eupatorium ageratoides, Solidago radula, S. rigida* and *S. speciosa.* From July or August on *Vernonia noveboracensis,* occurring in clumps, has been in full bloom. At this time too, the Labiatae form an important part of the ground cover, especially *Monarda fistulosa, Pycnanthemum muticum pilosum* and *P. linifolium.* These occur ordinarily in small clumps composed of but a few plants.

Dry hilltops.

The oaks occurring here, besides *Quercus coccinea tinctoria,* are *Q. alba, Q. Muhlenbergii, Q. nigra, Q. stellata* and *Q. Schneckii* which, with *Carya alba, C. porcina odorata, C. tomentosa* and *Sassafras officinale,* form the main aspect. The trees being farther apart than in the typical oak forest and often even isolated, an opportunity is offered for the growth of numerous species ordinarily not found in the latter formation, including trees, shrubs and herbs. Among the trees is *Robinia Pseudacacia* of which isolated specimens are met with here, as is the case with *Prunus serotina* which here perhaps reaches its greatest development. Though of this species a single large tree is sometimes found here, it ordinarily forms thickets, alone or with *Rhamnus caroliniana, Rhus copallina, R. glabra* and *Viburnum prunifolium.* It is to be noted that the herbaceous plants on the dry hilltops are chiefly those whose seeds are capable of being transported by wind.

The spring flora is not as characteristic in this location, and consists of *Anemonella thalictroides, Ranunculus fascicularis* and *Capsella Bursa-pastoris,* together with *Viola pedata,* which here reaches its highest development and of which sometimes the variety *bicolor* is found. The rosette character of the spring flora is further emphasized by plants of *Erigeron bellidifolius, Gnaphalium polycephalum, Androsace occidentalis, Verbascum Thapsus, Verbena Aubletia* and *Plantago patagonica aristata.* Specimens of *Comandra umbellata, Sisyrinchium albidum, S. anceps* and *Nothoscordum striatum* occur with varying frequency.

During the summer *Helianthus occidentalis, Rudbeckia hirta, Solidago rigida, Verbesina helianthoides, Lobelia in-*

flata and *L. leptostachys, Apocynum androsaemifolium, Asclepias tuberosa* and *A. verticillata,* as well as *Verbascum Thapsus, Sabbatia angularis, Cunila Mariana* and *Monarda Bradburiana* are prominent, while in late summer and early fall the Compositae seem to occupy the entire space, though *Monarda punctata* remains in bloom till late in the year. The autumn vegetation is made up mainly of *Aster patens, A. turbinellus, Helianthus occidentalis, Rudbeckia triloba* and *Solidago rigida.* In summer *Juncus tenuis, Carex oligocarpa, Agrostis alba, Danthonia spicata, Festuca tenella,* and *Panicum depauperatum* are everywhere. Two ferns, *Aspidium marginale* and *Pteris aquilina,* are found from spring till autumn.

Limestone glades.

Limestone glades are rather frequently occurring areas of small scope, ordinarily of great elevation, where the surface is but little inclined. As a result of these conditions the greater part of the soil formed is washed away by heavy rains and the limestone retains but a scant covering of soil. Though the heavy rains are sufficient to carry off most of the soil, the drainage of limestone glades appears to be poor. Especially in spring time the soil is exceedingly wet, the water draining away but slowly, probably through fissures in the limestone by which the water is carried off to larger underground channels, and lost to the plants of the limestone glade. As a result, such localities have a limited flora at best. They are usually covered with an excessive growth of *Sassafras officinale,* represented by numerous small trees, probably suckers, originating from the few older trees occurring there. The reason that so few of the latter are met with in similar localities lies probably in the fact that the development of a root system is so modified by the underlying limestone that the trees can not secure a sufficient foothold to withstand the early summer storms, occurring at a time when the ground is greatly softened. Evidence of this is found in the stumps and rotting sassafras logs, so often met with in limestone glades. Besides sassafras there is very little woody growth, it being limited to *Rhamnus lanceolata* and *Diospyros vir-*

giniana, specimens of *Rosa blanda* and *R. humilis* not being uncommon.

In spring the ground cover is composed of occasional specimens of *Delphinium tricorne*, *Arabis ludoviciana*, *Draba cuneifolia*, *Arenaria patula*, *Polygala verticillata*, *Astragalus mexicanus*, *Houstonia purpurea*, *Camassia Fraseri*, *Nothoscordum striatum* and others. *Cacalia tuberosa* makes its appearance in the spring, as does *Silphium integrifolium*, to remain throughout the summer and fall. *Opuntia Rafinesquii* and *Agave virginica* are typical here. An excellent illustration of the latter species in this locality is given by Miss Mulford.* The grasses ordinarily met with are *Bouteloua racemosa*, *Danthonia spicata* and *Panicum depauperatum*.

The early summer presents the largest number of species. The principal plants are *Silene antirrhina*, *Ascyrum Crux-Andreae*, *Hypericum nudicaule*, *Crotalaria sagittalis*, *Lespedeza capitata*, *Petalostemon violaceus* and *P. candidus*, *Gaura biennis*, *Polytaenia Nuttallii*, *Pimpinella integerrima*, *Thaspium aureum*, and *Blephilia ciliata*. In autumn these are largely replaced by Compositae, such as *Aster laevis* and *A. oblongifolius*, *Eupatorium altissimum*, *Solidago petiolaris* and *S. rigida*. *Gerardia tenuifolia* is frequent at this time as are *Andropogon furcatus* and *A. scoparius*. *Pteris aquilina* is common throughout the year.

Sinkholes.

As indicated above, sinkholes in the deciduous forest may be either dry or wet. Where dry, i. e. where a drainage system is present, they harbor plants which are usually referred to as appreciating a well drained soil (plate 13). *Hydrastis canadensis*, *Oxalis violacea*, *Polygonatum giganteum*, *Smilacina racemosa*, *Arisaema Dracontium* and *A. triphyllum* occur here in greatest abundance. They form the most important portion of the flora of sinkholes during the spring and summer months, together with *Sanicula marylandica*, *Spiraea Aruncus* and occasional ferns such as *Adiantum pedatum*, *Aspidium acrostichoides*, and *Cystopteris fragilis*.

* Mulford, A. I. A Study of the Agaves of the United States. Rept. Mo. Bot. Gard. **7.** *pl. 26.* 1896.

It is to be noted that *Hydrastis canadensis* forms large patches to the exclusion of all other species, as is true to some extent of *Arisaema triphyllum*, *Polygonatum giganteum* and *Smilacina racemosa*. *Oxalis violacea* ordinarily occurs singly. Occasionally *Passiflora lutea* is met with. The aerial portion of most of the plants just mentioned dies off in early fall, leaving the sinkhole comparatively bare. This forms a great contrast with the sinkholes occurring in the open plain. Here again dry and wet sinkholes are to be considered. The dry sinkhole in the plain is usually surrounded by shrubbery, composed chiefly of *Euonymus atropurpureus*, *Staphylea trifolia*, *Rhus Toxicodendron*, *Pyrus coronaria*, *Sambucus canadensis* and *Ribes gracile*, through which *Vitis cordifolia* twines. Occasionally a few oaks or hickories or a solitary *Platanus occidentalis* overtop the shrubbery, evidently a survival from a period when the drainage of the sinkhole was temporarily interrupted. The inner, upper portion of the sinkhole usually accommodates numerous smaller, stunted specimens of *Ribes gracile* together with briars and brambles. The central portion of the sinkhole is ordinarily bare, the water which at each rain rushes past to escape through the fissure, sometimes as much as two feet in diameter, preventing the establishment of any plants. On the sides are found occasional specimens of *Arisaema Dracontium*, *Arisaema triphyllum* and *Smilacina racemosa*. Neither *Hydrastis canadensis* nor *Commelina virginica*, so frequent in sinkholes in woods, is ordinarily met with here. Nor are the ferns which frequent the latter encountered. On the other hand, *Passiflora lutea* is far more common. When, as frequently happens, one of the edges of a sinkhole in the open plain is bare of shrubbery, *Hypericum Drummondii*, *Desmodium Dillenii* and *Eryngium yuccaefolium* are found during the summer months.

The wet sinkhole in woods, more familiar as a wooded pond, has a flora distinctively its own.

Wooded ponds.

Here and there the forest formation is interrupted because of small ponds which are the result of the obstruction of the drainage of sinkholes. As a result, not only is the sink-

hole filled with water but the latter also accumulates over the ground which immediately surrounds the sinkhole and which ordinarily has a slight slope towards it. It is evident that the water will continue to encroach upon the ground till an equilibrium shall have been established between the water supply and the evaporation. Ordinarily the wooded ponds are therefore quite shallow with the exception of an area of great depth at or near the center. Hence we never find the central portion occupied by plants whose roots penetrate the mud, but by floating forms only.

Wooded ponds permit the growth of the more water-loving species of oak, occasionally associated with specimens of *Platanus occidentalis* (plate 12, 1). The larger amount of light permits the existence of numerous shrubs which, however, belong to comparatively few species, *Staphylea trifolia* being prominent at some distance from the water, where *Cephalanthus occidentalis* is abundant. *Vitis cordifolia*, *Vitis riparia*, *Rhus Toxicodendron*, *Smilax herbacea* and *S. hispida* are the principal creepers.

The herbaceous flora is a distinct rosette formation, the xerophytic character possibly being due to too great an amount of water in the soil, interfering with the necessary life processes. This is borne out by the opinion expressed by Nillson* quoted by Coulter.† The principal components are *Arctium Lappa minus*, *Solidago Drummondii*, *S. canadensis*, *S. ulmifolia*, *Erigeron canadensis* and *Brunella vulgaris*. As to the hydrophytic flora, *Heteranthera limosa* and *Pontederia cordata* together with *Jussieua repens* on the one hand, and *Lemna perpusilla* and *Wolffia punctata* on the other, are the principal species. The presence of large quantities of *Riccia natans* must also be mentioned.

In sharp contrast to the wooded pond stands the open pond, i. e. the wet sinkhole in the field. All woody plants are absent with the exception of an occasional specimen of *Cephalanthus occidentalis*. The main flora around the wet

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* Nillson, H. Einiges ueber die Biologie der schwedischen Sumpfpflanzen. Bot. Centralbl. **76 :** 9. 1898.

† Coulter, S. M. An Ecological Comparison of some Typical Swamp-Areas. Rept. Mo. Bot. Gard. **15 :** 39. 1904.

sinkholes consists of grasses and sedges, chiefly *Cyperus acuminatus* and *C. erythrorhizos*, *Dulichium spathaceum*, *Eleocharis acicularis*, *Scirpus lacustris*, *Glyceria nervata* and *Leersia oryzoides*. Ordinarily the wet sinkholes in the field are of small depth, the soil from the surrounding slopes being washed down in great quantities, not being retained by roots, etc, as in the case of a wooded pond. Hence the majority are sufficiently shallow to accommodate species of *Sagittaria*, especially *S. variabilis*. Algae occur here in large quantities, as they do in the wooded ponds or in the bodies of water in the American Bottom.

Shaded hillsides.

The well drained, shaded hillsides offer optimum conditions to the plants of the region studied. Not only do they possess excellent drainage but soil is continually washed down from the higher slopes while at the same time the humus locally formed is, for the greater part at least, retained. The oaks, while still dominant, are not arranged as densely as in the dry, open wood, and shrubs are abundant. The species of oak are the same as indicated for the last named locality (*Quercus coccinea tinctoria*, *Q. imbricaria*, *Q. Muhlenbergii*, *Q. nigra*, *Q. Schneckii*, *Q. stellata*), but they are interspersed with numerous specimens of *Ulmus fulva*. *Cercis canadensis* is prominent. The principal shrubs are *Ptelea trifoliata*, *Euonymus atropurpureus*, *Ceanothus americanus* and *Rhamnus lanceolata*, with an undergrowth of smaller shrubs such as *Rhus glabra*, *Rhus canadensis* and *Symphoricarpus vulgaris*. *Ampelopsis quinquefolia* climbs the larger stems and *Vitis riparia* and *Rhus Toxicodendron* twine among the bushes. The spring and the fall flora again are the most prominent. *Hydrastis canadensis*, *Delphinium tricorne*, *Podophyllum peltatum*, *Viola palmata* and *V. palmata cucullata*, *Geranium maculatum*, *Geum album*, *Heuchera americana*, *Sanicula marylandica*, *Polygonatum giganteum* and *Smilacina racemosa* are the most prominent spring species. *Trillium recurvatum* and *T. sessile* are not infrequent. *Claytonia virginica*, wherever an open space occurs, blooms in profusion during March and April. It is to be noted that the blooming

season of this plant may be interrupted, the interruption sometimes lasting a month or more. This was especially to be noticed during the spring of 1907, in which year the unusually warm weather during February and March, followed by a cold period with killing frosts, brought about a second flowering period of *Claytonia virginica* during May.

In the early summer an occasional specimen of *Anemone caroliniana*, very rare on the Missouri side of the section studied, is met with. Not abundant is *Aralia quinquefolia*. *Ranunculus fascicularis* is not infrequent. The principal sedges and grasses are several species of *Carex*, especially *C. laxiflora latifolia*, *Melica diffusa* and *Muhlenbergia diffusa*. In drier places *Hypoxis erecta* is frequent.

During the fall the Compositae give the tone to the whole, principally *Eupatorium ageratoides* and *E. altissimum*, *Rudbeckia triloba*, *Solidago ulmifolia*, *Verbesina helianthoides* and *Vernonia noveboracensis*, though *Pycnanthemum lirifolium* is frequent.

Ravines.

The flora of such small ravines as open into the valley of the river combine with their typical mesophytic flora not a few of the xerophytes which have wandered in from the adjoining bluffs, as well as the hydrophytic flora derived from springs and hillside creeks, thus forming a very striking modification of the deciduous oak forest. Owing to the underground drainage, only moisture-loving oaks such as *Quercus alba*, *Q. coccinea tinctoria*, *Q. macrocarpa*, *Q. Muhlenbergii* and *Q. rubra* occur here. They, with *Sassafras officinale*, *Acer saccharinum*, *Juglans cinerea*, *J. nigra*, *Carya amara* and *C. olivaeformis*, are the principal trees. The smaller trees and shrubs as a rule never form thickets but are solitary or subsolitary. These are *Asimina triloba*, *Ceanothus americanus*, *Cercis canadensis*, *Hydrangea arborescens*, *Viburnum rufotomentosum* and *Lindera Benzoin*.

Herbaceous growth is well represented throughout the seasons. In spring the Ranunculaceae are numerous, the principal species being *Actaea alba*, *Anemone virginiana*, *Ranunculus abortivus*, *R. recurvatus*, *R. repens* and *R. septentrionalis*. A little later, *Impatiens fulva*, properly belong-

ing on the lower hillsides, makes its appearance bordering the creeks. *Oxalis stri* is frequent as is *Sanicula marylandica* and *S. mar ndica canadensis*. Not infrequent, but never abund are orchids, especially *Cypripedium pubescens*. The s s true for *Arisaema Dracontium* and *A. triphyllum*, *A ium ebeneum* and *Botrychium virginianum*. The lat lant occurs especially where there are large fissures in the limestone rocks partly filled with colluvial soil. This plant,—and the same is true for *Ophioglossum Engelmanni*,—delights in constant moisture, and the limestone fissures, the soil in which is ordinarily covered with moisture-retaining mosses, offer an excellent location. However, since in the immediate vicinity of the Mississippi river the dip of the limestone is but slight, crevices adapted to the growth of the two species just mentioned are not numerous. Farther west, especially, in our territory, in the bluffs on the east side of the Meramec river, where the influence of the Ozark uplift is more pronounced, the dip allows the existence of numerous pockets adapted to the needs of both *Botrychium virginianum* and *Ophioglossum Engelmanni*. Mosses are abundant, covering the ground and running over stones. Most frequent are *Amblystegium serpens* and *A. varium*, *Physcomitrium turbinatum* and *Mnium cuspidatum*.

With the advent of summer those species which are typically vernal-flowering disappear. Such are *Sanguinaria canadensis* and *Claytonia virginica*. On the other hand, many which during the spring were present as rosettes only now begin to bloom, among them the later-flowering species of Ranunculus, such as *R. repens*. *Hydrophyllum canadense*, *Solanum nigrum* and *Seymeria macrophylla* make their appearance. Noticeable is the presence of *Passiflora lutea* and of *Blephilia hirsuta* which takes the place of *B. ciliata* occurring in the dry, open wood. Similarly *Cassia nictitans* replaces *C. marilandica*. During the summer several additional mosses become evident, principally *Cylindrothecium Macounii* and *Ditrichum pallidum*. *Cladonia pyxidata* is the only lichen occurring with frequency. At the mouth of springs *Marchantia polymorpha* is regularly met with.

In the fall the herbaceous plants are represented largely

by Compositae, with the exception of specimens of *Actaea alba*, the fruit of which is in evidence during the early part of the autumn, and *Galium Aparine*, *G. circaezans*, *G. concinnum* and *G. pilosum*, which continue to clothe the banks and shelves, the former on the lower hillside, the latter on the upper. Among the Compositae, *Eupatorium altissimum* and *Solidago latifolia* are most prominent. A moss *Atrichum angustatum*, makes its appearance at this time.

A special feature of a ravine is the creek which finds its way through it. In early spring filled to overflowing and even frequently inundating its banks, during the summer and fall it merely serves as an outlet for the underground drainage which never fails though it may be reduced to a minimum. Algae, especially *Cladophora glomerata*, the latter species even through the winter, are present during the entire year. Besides Bacillariaceae and Desmidiaceae, one meets with *Gonium pectorale*. A species of *Phormidium* covers the stones. In summer and fall *Euglena acus* and *E. viridis* are frequently met with.

Creek banks.

The trees occurring on the creek banks are *Acer saccharinum*, *Fraxinus americana*, *F. viridis*, *Celtis occidentalis*, *Morus rubra*, *Ulmus americana*, *Platanus occidentalis*, *Betula nigra*, *Carpinus caroliniana*, *Quercus alba*, *Q. coccinea tinctoria*, and *Q. macrocarpa*. The smaller trees and shrubs which find a place here are *Ptelea trifoliata*, *Rhamnus lanceolata*, *Staphylea trifolia*, *Physocarpus opulifolius*, *Prunus americana*, *P. serotina*, *Sambucus canadensis*, and *Viburnum Lentago*, together with *Rosa setigera* and *Hydrangea arborescens*, the latter species forming extensive groups. Climbers such as *Ampelopsis quinquefolia*, *Cissus Ampelopsis*, *Vitis cinerea*, *V. cordata* and *V. riparia* as well as *Rhus Toxicodendron* are everywhere, as are the shoots of *Smilax herbacea*, *S. hispida* and *Tecoma radicans*, the latter at least in the more open places.

The spring flora consists largely of rosette forms, the Ranunculaceae and liliaceous group yielding the largest contingent. The principal species are *Delphinium tricorne*,

Hydrastis canadensis, Ranunculus abortivus, R. septentrionalis, Podophyllum peltatum, Capsella Bursa-pastoris, Claytonia virginica, Geranium maculatum, Oxalis stricta, Callitriche deflexa Austini, Circaea Lutetiana, Chaerophyllum procumbens, Sanicula marylandica canadensis, Senecio aureus, Phlox divaricata, Ellisia Nyctelea, Monarda fistulosa, Nepeta Glechoma, Erythronium albidum, Trillium recurvatum and *T. sessile, Uvularia perfoliata, Arisaema Dracontium* and *A. triphyllum,* two or three species of *Carex, Elymus striatus* and *Poa pratensis,* and numerous excellent specimens of *Adiantum pedatum* and *Cystopteris fragilis.*

While most of these species are present during the summer, they become less striking owing to the appearance of numerous other species, especially of Compositae and Labiatae. Among the former are *Actinomeris squarrosa, Coreopsis tripteris, Eupatorium purpureum, Helenium nudiflorum, Rudbeckia laciniata* and *Xanthium canadense.* Striking are the masses of *Echinocystis lobata* and *Sicyos angulatus* which become evident about this time on the lower banks, shortly to form an almost impenetrable curtain. Autumn does not bring any marked changes on the creek banks, very few species being added.

Prairies.

The prairies which cover limited areas of the Missouri plateau owe the peculiar character of their vegetation to a combination of geological, physiographical and meteorological conditions. The practically horizontal stratification of the St. Louis limestone, which here is covered by loess, and the slight differences in level, afford but little drainage to the large amounts of precipitation during the earlier part of the year when the amount of evaporation is slight. When finally this moisture seeps away through the fissures in the limestone, it is permanently lost. In contrast to the almost swampy conditions of the spring, the soil, during summer and autumn, is dry, the evaporation being largely in excess of the precipitation and the underground drainage almost nil. Hence the spring brings a luxurious growth of grasses and is the only period when sufficient moisture is present for

seeds to germinate. As a result there is a profuse spring flora composed of annuals, and a summer flora consisting of annuals the seeds of which germinated during the spring months, together with some of the perennials which are typical of the fall aspect of the prairie. Chief among the earlier plants are *Carex grisea*, *Agrostis alba* and *A. scabra*, *Danthonia spicata*, *Elymus striatus*, *Festuca tenella*, *Phleum pratense*, *Poa compressa* and *P. pratensis*. Here and there, in the bottom of slight valleys or in the vicinity of sinkholes, where the ground is swampy, one meets with *Carex laxiflora*, *C. lupulina*, and *C. riparia*, *Cyperus erythrorhizos*, *Elymus canadensis*, *Eragrostis reptans*, *Glyceria nervata* and *Panicum Crus-galli*. Where there is a slight elevation *Panicum depauperatum* is dominant. When, with the increase of evaporation, the prairies become dry, most of the species just enumerated disappear. Their places are taken by others, especially *Andropogon furcatus*, *A. scoparius* and *Eatonia obtusata*.

Grasses, though numerically the most important members of this prairie flora, are not by any means the most striking. During the late fall they are but little in evidence, their decaying stems forming a light-colored mat. Between the broken, prostrate stems of the fall-blooming Compositae are bright patches of green derived from the winter rosettes of several perennials. The typical winter rosette of *Lechea major* is striking. Patches of *Trifolium repens*, rosettes of *Capsella Bursa-pastoris*, of *Oenothera biennis* and its variety *muricata*, clumps of *Achillea Millefolium* and isolated dark green rosettes of *Arctium Lappa minus* and *Cnicus pumilus*, everywhere catch the eye, as do the rosettes of *Verbascum Thapsus*, *Verbena angustifolia*, *V. Aubletia*, *V. stricta* and *V. urticaefolia*, *Brunella vulgaris* and *Plantago Rugelii*. The brilliant yellow fruits of *Solanum carolinense* are found lying in all directions among the decaying herbs. Striking are large patches of *Croton capitatus* of which only the dried branches remain, still bearing the fruit. Here and there appear the bleached skeletons of *Datura Tatula*, while the browning stalks of evening primrose, pokeroot, mullein and numerous Compositae, give the whole a ragged appearance.

Most of the plants just mentioned do not attain their full

development till late summer. While several, such as *Capsella Bursa-pastoris*, *Trifolium repens* and *Achillea Millefolium* produce flowers during the spring months, chiefly annual species are to be found in bloom at this time. The drier places are occupied by *Viola Rafinesquii*, *Plantago virginica* and *Antennaria plantaginifolia*. Where the ground is very moist one finds *Myosurus minimus*. Other species now appearing and flowering are *Lepidium virginicum*, *Sisymbrium canescens*, *Helianthemum canadense*, *Cerastium viscosum*, *Polygala verticillata* and *Androsace occidentalis*. Rosettes of fall-blooming species begin to develop, such as those of *Lactuca Scariola*, *L. Scariola integrata*, and *Verbascum Blattaria*. *Plantago patagonica aristata*, *P. pusilla* and *P. Rugelii* are frequent. *Rumex Acetosella* occurs everywhere as do rosettes of *Rumex obtusifolius*. *Allium cernuum* sometimes covers large patches. To these, the summer months add *Sisymbrium officinale*, *Hypericum maculatum*, several Leguminosae, especially *Cassia Chamaecrista*, *Lespedeza capitata*, *Psoralea tenuiflora* and *Stylosanthes elatior*, *Diodia teres*, *Apocynum androsaemifolium*, *Asclepias tuberosa* and *A. verticillata*, *Physalis angulata*, *Isanthus caeruleus* and *Sisyrinchium anceps*. *Abutilon Avicennae*, *Datura Tatula*, occasionally also the white-flowered *D. Stramonium* and the brilliant red shoots of *Phytolacca decandra* elevate themselves above the rest of the vegetation as do the flower stalks of *Oenothera biennis*, *O. biennis muricata*, *Verbascum Thapsus* and *V. Blattaria*. At this time too the Compositae have reached and in some cases passed their full rosette growth, though late summer and early autumn find them at their zenith. Species of *Helianthus*, *H. grosse-serratus*, *H. laetiflorus*, *H. mollis*, *Heliopsis laevis* and *H. scabra*, together with *Cnicus arvensis* (rare) and *C. pumilus*, *Erigeron canadensis*, *Lactuca Scariola*, *L. Scariola integrata* and *Silphium terebinthinaceum* are the first to flower. They are followed by the Asters, *A. novae-angliae*, *A. oblongifolius*, *A. patens* and *A. sagittifolius*, and these in their turn by the goldenrods of which *Solidago canadensis*, *S. nemoralis* and *S. petiolaris* are the most common, *S. serotina* being less common here and *S. speciosa* rare. *Aster sagittifolius* is the last to flower during November,

at which time the prairies gradually assume their winter aspect.

Thickets.

Bordering the prairie and forming a transition between it and the deciduous oak forest, one finds an accumulation of shrubs of greater and lesser heights, causing the one to grade into the other. This thicket is fringed with low growing shrubs such as the early flowering *Rhus canadensis*, *Ribes gracile* and *Symphoricarpus vulgaris*, the brilliant red fruit of which forms a striking feature of the landscape during the winter months and to which the plant owes its name of coral berry. These are succeeded by taller shrubs, notably *Rhus glabra* and *Sambucus canadensis*, with which, in different localities, *Euonymus atropurpureus*, *Cercis canadensis*, *Rhamnus lanceolata*, *Pyrus coronaria* and *Cornus asperifolia* are associated in greater or smaller numbers, one of the species usually being subdominant. On the plateau at Jefferson Barracks, south of the buildings, *Prunus Persica* in places forms extensive thickets. The undergrowth is composed of various shrubby Rosaceae, notably *Rosa arkansana* and *R. blanda*, *R. humilis* being less frequent, *Rubus canadensis*, together with *Rubus occidentalis* and *R. villosus*. Grape vines, *Vitis riparia*, as well as *Celastrus scandens*, *Menispermum canadense* and *Smilax ecirrhata*, *S. herbacea* and *S. hispida* twine through the bushes as does, in the latter part of the year, *Polygonum dumetorum scandens*. *Rhus Toxicodendron* in places is abundant. This happens especially where the outer fringe of the thicket is composed almost exclusively of *Rubus canadensis*, which in late summer and fall is sometimes completely hidden by the poison oak. The forest trees which border the prairie are chiefly *Quercus alba*, *Q. coccinea tinctoria* and *Q. Muhlenbergii*, an occasional large specimen of *Platanus occidentalis* being found. *Quercus stellata* is frequent here.

Between the outer fringe of *Symphoricarpus vulgaris* and the prairie proper lies a narrow zone, encroaching upon both, and occupied by herbaceous plants. In the earlier portion of the year *Claytonia virginica*, *Viola palmata* and *V. palmata*

cucullata, Geranium maculatum, Oxalis stricta and *Phlox divaricata* occur. Later some of these disappear and give place to *Geum album, Potentilla canadensis, Heuchera americana, Oxalis cymosa, Erigeron annuus, Polemonium reptans, Cynoglossum virginicum, Hedeoma pulegioides, Scutellaria canescens* and *S. versicolor*. In the fall *Galium Aparine, G. concinnum, Eupatorium ageratoides,* and *Vernonia noveboracensis* take their places, as do *Monarda fistulosa* and *Pycnanthemum linifolium,* the rosettes of which have been in evidence during the greater part of the year. Where the thicket is more or less open, one finds, during the spring months, *Delphinium tricorne, Thalictrum purpurascens, Podophyllum peltatum, Cypripedium pubescens, Arisaema Dracontium,* and *A. triphyllum.*

THE MISSOURI BLUFF.

The cliff.

This, on the Missouri side, is limited to the upper portion of the bluff, the walls of which are almost perpendicular and sometimes even concave. Here and there ledges occur on which soil accumulates as it does in the numerous crevices of the limestone. Occasionally larger blocks of the latter have become separated from the main body, and, being thus more exposed to the action of the elements, show the full extent of the disintegration caused partly by the weather, partly by the dissolving influence of the water and partly by plant action (plate 12, 2). The shallowness of the soil and the exposed position, resulting in an almost total loss of the water of precipitation by drainage and evaporation, bring with it a rather luxuriant spring flora composed chiefly of rosette-forming annuals, and a fall flora of rosette-forming biennials and perennials. The principal vernal plants are *Arabis canadensis, Capsella Bursa-pastoris, Draba cuneifolia, Erysimum asperum, Lechea major, Silene antirrhina, Astragalus mexicanus, Polygala verticillata, Heuchera hispida, Androsace occidentalis, Phlox pilosa, Lithospermum canescens, Monarda Bradburiana* and *Scutellaria parvula.* The principal spring grasses are *Melica diffusa* and *Panicum depauperatum.* Numerous perennials enlarge their rosettes at this

time, notably *Eryngium yuccaefolium*, *Verbascum Thapsus* and *Agave virginica* as well as several Compositae. *Gymnostomum curvirostre* is the moss chiefly encountered. It may be found here during the entire summer. Lichens cover the surface of the rocks, principally *Parmelia capitata*, *Physcia stellaris* and *Peltigera rufescens*.

During the summer this flora is augmented by *Polanisia graveolens*, derived from the plants on the railroad tracks at the foot of the bluff, *Hypericum maculatum*, *Linum virginicum*, *Pimpinella integerrima*, *Sporobolus asper* and *S. vaginaeflorus*. In the fall Compositae are most prominent, especially *Aster oblongifolius* and *A. novae-angliae*, *Coreopsis palmata*, *Solidago Drummondii* and *S. ulmifolia*. A fern, *Pellaea atropurpurea*, is to be found here throughout the year, taking advantage of the slightest amount of soil in crevices; *Cheilanthes lanuginosa* and *Woodsia obtusa* are met with from spring till autumn. Trees and shrubs have found lodgment here and there, but are neither frequent nor abundant. They include, beside the local species of *Rhus*, *Amelanchier canadensis* and *Fraxinus viridis*. The principal creeper is *Tecoma radicans*.

At the top of the bluff there frequently occurs a narrow strip, but a yard or so wide, which appears to be occupied mainly by *Panicum depauperatum*, Leguminosae and Compositae, while in spring *Capsella Bursa-pastoris* and *Androsace occidentalis* are quite common. While the Compositae are those of the cliff proper, with the addition of *Rudbeckia hirta*, the Leguminosae form a feature not possessed by the cliff. They consist mainly of *Desmodium marilandicum*, *D. paniculatum*, *Psoralea tenuiflora* and *Stylosanthes elatior*. Here also occur large patches of *Cladonia fimbriata*. This, during the winter months, is practically the only species encountered here, just as the cliff flora is limited to the rosettes of *Lechea major* and *Verbascum Thapsus*, together with *Pellaea atropurpurea*.

Talus.

With the exception perhaps of the flora surrounding the lakes near the Illinois bluffs, there is no station in the entire section

studied which presents so great an assortment of species and genera, so luxuriant a plant growth, as does the talus of the Missouri bluffs. The flora combines many of the elements of the plateau forest, and of the ravine in addition to those of the cliff, while at the same time the railroad, which passes at the foot of the bluff, is instrumental in the introduction and distribution of not a few species. The numerous springs and the drainage from the plateau offer a never-failing source of moisture, the amount of which never, except perhaps in the early part of the year, becomes excessive, owing to the slope. The soil is of the richest since in addition to the humus locally formed, a large amount of colluvial soil is annually obtained from the plateau. The exposure being an eastern one, the plants have the benefit of the early morning sun and are protected from the too ardent afternoon rays. All these factors combine to bring about optimum conditions and are largely instrumental in enabling the talus to support a vegetation without parallel in this region.

Trees and shrubs are numerous. The most prominent are *Asimina triloba, Ceanothus americanus, Rhamnus caroliniana, Aesculus glabra, Negundo aceroides, Cercis canadensis, Fraxinus americana,* several species of *Quercus* and *Populus monilifera. Ilex decidua* occurs at Wickes only. The undergrowth is composed largely of *Celastrus scandens, Rhus Toxicodendron, Rosa setigera, Rubus occidentalis* and *R. villosus.*

While the foregoing species give the general aspect and clothe the lower hill with verdure, the herbaceous plants furnish the brighter colors, especially during the late summer and fall, when yellow is the dominant color. The spring brings with it various Ranunculaceae, such as *Anemone virginiana, Ranunculus abortivus* and *R. septentrionalis,* as well as other low growing species. These include *Podophyllum peltatum, Sanguinaria canadensis, Viola palmata, V. palmata cucullata, V. Rafinesquii, Claytonia virginica, Geranium carolinianum* and *G. maculatum, Trifolium pratense, T. repens, Fragaria virginiana, Potentilla canadensis, Chaerophyllum procumbens, Phlox divaricata, P. pilosa, Hydrophyllum appendiculatum, H. canadense,* and *H. virginicum, Lithospermum canescens,* with its striking, orange-colored

flowers, *L. latifolium*, *Brunella vulgaris*, *Trillium recurvatum* and *T. sessile*, *Polygonatum giganteum*, *Smilacina racemosa*, *Arisaema Dracontium* and *A. triphyllum*, as well as numerous mosses, liverworts and lichens, which, together with *Nepeta Glechoma*, run over the ground and rocks. On the whole, the spring flora is a rosette formation, differing only numerically, both as to species and individuals, from the flora of the cliff. As soon as the too abundant water has disappeared, partly owing to a diminution of the drainage from the plateau, partly because of an increase in evaporation, a most luxuriant summer flora makes its appearance, in which Leguminosae, Umbelliferae, Compositae and Labiatae are best represented. *Astragalus canadensis*, of which the rosettes bore flowers in April, is seconded by *A. mexicanus*. *Cassia Chamaecrista*, *Desmanthus brachylobus*, *Strophostyles angulosa* and *Schrankia uncinata* appear. *Discopleura Nuttallii*, *Eryngium yuccaefolium* and *Osmorrhiza brevistylis* make their appearance as isolated individuals. *Sanicula marylandica* is everywhere. Different Compositae, mainly *Helianthus grosse-serratus* and *H. hirsutus*, as well as *Rudbeckia laciniata*, have begun to produce their first flowers, while here and there clumps of *Monarda fistulosa*, *Pycnanthemum linifolium* and *Scutellaria canescens* add patches of bright green. *Galium Aparine* and *G. concinnum* appear at the edges, as does *Tradescantia virginica*, together with grasses, chiefly *Muhlenbergia glomerata* and *Uniola latifolia*. *Polygonatum giganteum* has now reached its highest development and occurs in specimens which truly make the plant deserve its specific name. In the late summer and fall, besides *Impatiens fulva*, *Cassia marylandica* and *Campanula americana*, Compositae such as *Eupatorium ageratoides*, *E. coelestinum*, *Rudbeckia laciniata*, *Silphium integrifolium*, *Solidago latifolia* and *Vernonia noveboracensis*, occur frequently. The winter aspect of the talus is derived chiefly from the shrubs and trees.

THE RAILROAD RIGHT OF WAY.

Ditches.

These, bare during the winter, except for the rosettes of *Capsella Bursa-pastoris* and *Taraxacum officinale*, and

cleared at various times during the year, harbor none but species with perennial roots or those the seeds of which are produced in great abundance. The spring flora, in addition to the two species just mentioned, is limited chiefly to the Carices, and it is the summer which brings a comparatively large number of species, many of them water-loving. Among them *Lactuca Scariola, L. Scariola integrata, Lippia lanceolata, Stachys palustris, Oxybaphus nyctagineus,* and species of *Polygonum,* are prominent. Where there is standing water one sometimes meets with *Typha latifolia* and *Lemna perpusilla.* This summer aspect is not materially changed during the autumn.

The embankment.

The railroad tracks themselves do not present conditions favorable to plant growth and this is limited to occasional rosettes of *Capsella Bursa-pastoris, Lepidium virginicum, Portulaca oleracea, Taraxacum officinale, Amaranthus retroflexus* and *Mollugo verticillata,* both the *Amaranthus* and the *Portulaca* not appearing till the year is well advanced, while the rosettes of *Mollugo verticillata* remain till the October frosts kill them.

The land on either side of the track harbors a large number of species. The stretch next to the hillside is occupied mainly by many of the herbaceous plants which properly belong there while the opposite side bears numerous grasses or a growth of *Rhus glabra,* which from time to time, and especially during the late summer, is cleared away, being cut and subsequently burned over (plate 16). Among the principal grasses, besides *Poa pratensis,* are *Asprella Hystrix, Bromus secalinus, Dactylis glomerata* and *Phleum pratense,* to which, during the summer, *Eleusine indica, Panicum sanguinale,P halaris canariensis, Setaria glauca, S. italica, S. viridis* and *Triodia cuprea* are added. *Hypericum perforatum, Oenothera biennis, Matricaria discoidea* and *Verbascum Thapsus,* as well as *Commelina communis* and *C. virginica* are typical here, as are the different species of *Plantago. Abutilon Avicennae, Rhus Toxicodendron, Achillea Millefolium, Lactuca leucophaea integrifolia, L. Scariola*

and *L. Scariola integrata, Datura Tatula* and *Tecoma radicans* never fail. *Daucus Carota* which, coming from the west, has increased to a remarkable extent during the last five years, sometimes covers extensive tracts. *Polanisia graveolens,* introduced with the railroad ballast obtained from the Meramec River gravelbars, is met with. Compositae are always a most striking feature. They are chiefly *Helianthus annuus, Rudbeckia hirta, Silphium integrifolium, Solidago canadensis* and *S. serotina.*

Cuts.

Here and there, where cuts have been made in grading the railroad, banks, some six feet in height, separate the tracks from the bottom lands. These banks support a flora largely composed of low growing herbs, or at least of those plants which form spring rosettes, the conditions being strictly xerophytic. Striking is, during the spring months, *Corydalis aurea.* Here and there brambles have taken possession. The Ranunculaceae are conspicuous by their absence. Grasses, chiefly *Poa pratensis* and *P. compressa, Bromus secalinus* and *Elymus canadensis,* together with *Fragaria virginiana* and *Potentilla canadensis,* form the spring flora. *Sisyrinchium albidum* and *S. anceps,* as well as *Hypoxis erecta,* are not infrequent. During the summer Leguminosae dominate. *Melilotus alba,* throwing up tall shoots from its biennial root, is the most striking, especially during the late summer, while the yellow-flowered *M. officinalis,* less tall but more graceful, is not infrequent during the earlier part of the year. Several species of *Desmodium* and *Trifolium* are frequent. *Solanum rostratum* and the more abundant and more frequent *Solanum carolinense* occur, as well as patches of *Antennaria plantaginifolia* and clumps of *Achillea Millefolium.* During the fall Compositae of lesser stature are dominant, notably *Aster ericoides* and *A. multiflorus, Coreopsis tripteris, Erigeron canadensis, Silphium integrifolium* and *Solidago canadensis.*

Ponds.

Here and there along the railroad occur shallow ponds, filled with stagnant water and largely drying out during the

later part of the year. On their borders they support a vegetation composed mainly of Umbelliferae and Polygonaceae together with rushes and grasses. *Cicuta maculata* and *Sium cicutaefolium* are most frequent, as are *Polygonum Hydropiper*, *P. hydropiperoides*, *P. Muhlenbergii* and *P. Persicaria.* Several species of *Carex*, *Cyperus acuminatus*, *C. erythrorhizos*, *Dulichium spathaceum*, *Eleocharis acicularis*, *E. ovata*, *Eriophorum lineatum* and *Scirpus lacustris*, *Alopecurus geniculatus*, *Eragrostis reptans*, *Glyceria nervata*, *Leersia oryzoides*, *Panicum Crus-galli* and *Spartina cynosuroides* are frequent, as are patches of *Typha latifolia.* Different species of *Sagittaria* frequently occupy the major part of the ponds. Here and there *Alisma Plantago* occurs. While *Cephalanthus occidentalis*, either isolated or in groups, is ordinarily found at every pond, *Acer dasycarpum* and *Betula nigra* may likewise be encountered. Lythraceae-Onagraceae, such as *Ammania coccinea*, *Rotala ramosior*, and *Ludwigia palustris*, are not infrequent. *Jussieua repens*, though seldom absent, nowhere on the Missouri side attains the truly magnificent development exhibited in the American Bottoms. During the summer *Iva ciliata*, *Ilysanthes riparia*, *Mimulus ringens*, *Veronica peregrina*, *Lobelia syphilitica*, *Lycopus sinuatus* and *L. virginicus* are always found in the immediate vicinity of ponds. Later *Aster salicifolius*, *Coreopsis aristosa* and its variety *mutica* are added.

THE MISSOURI BOTTOM.

The dry bottom.

The dry bottom, on the Missouri side, comprises a strip some twenty to fifty yards wide immediately adjacent to the railroad tracks but situated several feet lower. Trees and shrubs are ordinarily isolated and consist of specimens of *Acer dasycarpum*, *Aesculus glabra*, *Gleditschia triacanthos*, *Gymnocladus canadensis*, *Robinia Pseudacacia*, *Amelanchier canadensis*, *Prunus serotina*, *Fraxinus americana*, *Ulmus fulva*, *Morus rubra* and *Betula nigra*, with here and there brambles and plants of *Vitis cinerea* and *V. riparia*, *Rhus Toxicodendron* and *Tecoma radicans.* The more common weeds occur with the greatest frequency, among them *Myosurus minimus*,

Ranunculus abortivus, Capsella Bursa-pastoris, Geranium carolinianum, Oxalis stricta, Melilotus alba, Trifolium repens, T. pratense, Chaerophyllum procumbens, Potentilla canadensis, Erigeron annuus and *E. canadensis*, different species of *Lactuca, Apocynum cannabinum, Verbascum Thapsus, Plantago lanceolata, P. patagonica aristata* and *P. Rugelii*, together with *Cyperus ovularis, Eleocharis tenuis, Agrostis scabra, Elymus striatus* and *Poa pratensis*. The summer adds to these *Anemone pennsylvanica, Abutilon Avicennae*, several species of *Lespedeza* as well as other Leguminosae, *Galium triflorum, Actinomeris squarrosa, Artemisia biennis, Bidens bipinnata, Erigeron strigosus, Eupatorium purpureum* and *E. serotinum, Rudbeckia laciniata, Xanthium canadense, Steironema ciliatum* and *S. lanceolatum, Asclepias Cornuti, A. obtusifolius* and *A. purpurascens, Enslenia albida, Convolvulus Sepium* and *Ipomoea pandurata, Datura Tatula, Solanum nigrum, Pentstemon laevigatus Digitalis, Blephilia hirsuta, Amaranthus retroflexus, Phytolacca decandra, Chenopodium album, Polygonum dumetorum scandens* and *Euphorbia Preslii*. In the fall *Helenium autumnale* and *Atriplex patulum hastatum* are added. Mention should be made of clumps of *Clematis virginiana* occurring here and there throughout the year.

The wet bottom.

In contrast to the dry bottom, the wet bottom supports a flora of great luxuriance, though not particularly rich in species. Willows here form the main tree growth, chiefly *Salix cordata* × *sericea, S. longifolia* and *S. nigra*, together with *Populus monilifera*, while close to the river lower plants of these species, together with small trees of *Betula nigra*, are very much in evidence, forming, together with a number of herbaceous plants, a broad hedge. Back of this hedge and gradually passing into the dry bottom, lies a strip, varying in width, but measuring on an average fully four fifths of the entire bottom, which may well be called a park landscape in miniature. The willows constitute small woods, the trunks being clear and the trees relatively close together. Smaller willows and small trees of *Betula nigra* form clumps of shrubbery among which numerous vines, *Cissus Ampe-*

lopsis, C. stans, Vitis cinerea, V. cordifolia, V. palmata and *V. riparia,* together with *Tecoma radicans,* find their way. At times the wild grapes entirely cover their support. *Echinocystis lobata, Convolvulus Sepium* and *Polygonum dumetorum scandens,* twine among the bushes (plate 14, 2). *Myosurus minimus, Ranunculus abortivus, R. septentrionalis, R. repens, Capsella Bursa-pastoris, Nasturtium obtusum, Cerastium nutans, Stellaria longifolia, Hypericum mutilum, Oxalis stricta, Oenothera biennis, Chaerophyllum procumbens, Valerianella radiata, Senecio aureus, S. aureus Balsamitae, Taraxacum officinale, Brunella vulgaris, Euphorbia humistrata* and *Allium cernuum* form a mat, together with the sedges and grasses, mainly *Carex conjuncta, C. granularis, C. monile, Scirpus atrovirens, Alopecurus geniculatus, Elymus virginicus, Eragrostis reptans, Leersia virginica, Panicum Crus-galli,* and *Spartium cynosuroides,* covering the intervening ground with verdure. Here and there single plants of *Hibiscus lasiocarpus* stand out prominently as well rounded clumps. A similar appearance is presented by plants of *Iris versicolor.* Different species of *Polygonum,* among which *P. Hartwrightii* is the most striking (plate 17) take possession of large tracts, especially where the ground is somewhat higher. Other species prominent during the summer and autumn are *Baptisia leucantha, Lespedeza capitata, Bidens cernua, Coreopsis aristosa, C. aristosa mutica, Eupatorium purpureum, E. serotinum, Helenium nudiflorum, Iva ciliata, Silphium perfoliatum, Vernonia fasciculata* and *V. noveboracensis, Asclepias incarnata, Blephilia hirsuta, Lophanthus nepetoides, Chenopodium ambrosioides* and *C. ambrosioides anthelminticum,* different species of *Rumex* and *Saururus cernuus.* In fall the Compositae, especially *Aster diffusus* and *A. salicifolius,* are most prominent. Among the plants whose presence is not so readily recognized must be mentioned numerous species of *Cuscuta.*

There exists a marked difference between the Missouri bottoms of the Mississippi and the bottoms of the River des Pères, near the spot where it enters the larger river. The bottoms of the River des Pères at this point show several terraces, the lower one of which is illustrated (plates 18, 19).

While the bottoms on the north side are covered chiefly by grasses, trees and shrubs form the most striking feature of the bottoms on the south side. The lower terrace is occupied in part by willows, *Salix cordata* × *sericea*, *S. longifolia*, *S. nigra* and *S. sericea*, and by *Forestiera acuminata*. Among the larger herbs *Vernonia noveboracensis* is most prominent. *Chaerophyllum procumbens* and *Senecio aureus* are striking features of the spring flora. This lower terrace has partly been invaded by the more common roadside weeds, such as *Arctium Lappa minus*. Species of *Verbena* are common. There are a few trees of *Ulmus americana* and *Gleditschia triacanthos*. *Forestiera acuminata* forms large clumps. The higher terraces are occupied by *Ulmus fulva* and oaks, chiefly *Quercus bicolor*, *Q. macrocarpa* and *Q. palustris*, by walnuts, *Juglans cinerea* and *J. nigra*, and by hickories, mainly *Carya amara*. Here occur two specimens of *C. olivaeformis*, the only representatives in our section on the Missouri side. Several species of *Crataegus* are found here.

In connection with the wet bottoms must be mentioned the great similarity of the flora of these regions to that of the swamps on the plateau, where the most striking features are willows and *Iris versicolor* (plate 14).

THE RIVER.*

The Missouri Shore.

On the Missouri side of the Mississippi, the river shore may be divided into three zones, which, in the earlier part of the year, ordinarily are submerged, appearing in summer and autumn only. The first zone, immediately adjoining the water, is from two to four yards wide and is composed of the St. Louis limestone, not covered by mud. Probably the constant change of level of the river, varying within a few feet, is sufficient to prevent the accumulation of any deposit. There is no vegetation unless of a transient nature and limited to algae left behind by the waters of the river in the small shallow pools, seldom more than one foot in diameter. In the second zone, with a width of from five to ten yards, the stones are

* The plankton of the Mississippi has been omitted from this study.

covered by a thicker or thinner layer (0–12 in.) of mud, which apparently supports no vegetation. There is a slight accumulation of driftwood. This is followed by the third and broader zone. Its lowest limit is the summer and fall level of the river. The width varies from twenty to forty yards. The lower portion is characterized by a strip, one foot wide and more or less undulating, occupied by *Cyperus acuminatus, C. diandrus* and *Fimbristylis autumnalis*. Separated from this by a strip of bare mud, about a foot in width, lies a strip about 12 inches wide, covered by dwarf plants of *Coreopsis aristosa mutica*. A third strip, again placed at about one foot distance and as broad, contains nothing but seedlings of *Salix longifolia*, from two to three feet high, interspersed with seedlings of *Betula nigra* and *Populus monilifera*. Here occasionally a rosette of *Capsella Bursa-pastoris* is seen. Numerous are small fronds of *Riccia natans*. The second part of this third zone, from fifteen to thirty-five yards wide, contains rosettes of *Capsella Bursa-pastoris* only, the rosettes being placed at some distance from each other. The upper portion of the third zone, situated considerably higher than the rest, shows small plants of *Nasturtium obtusum, N. palustre, Geranium carolinianum, Artemisia ludoviciana, Vernonia fasciculata, Samolus Valerandi americanus, Ipomoea purpurea, Solanum nigrum, Conobaea multifida, Lippia lanceolata, Acnida tuberculata, Rumex crispus* and *R. maritimus, Polygonum aviculare, P. hydropiperoides* and *P. Persicaria*, as well as the plants of the middle zone. Here too are rosettes of *Lactuca canadensis* and *L. Scariola integrata* as well as rosettes of *Daucus Carota*. In autumn rosettes of *Juncus tenuis*, at first sight readily mistaken for *Isoetes*, are numerous. In this zone belong the algae found in the small creeks, where *Cladophora glomerata* is most numerous, forming a green felt over the rocks. This species extends into the middle of the third zone.

As is but natural, the river shore proper is of an exceedingly variable nature. Not everywhere may the zones just described be found so clearly defined. In places the upper zone is but narrow, the current of the river having been deflected by an obstruction at some distance. As a result

river deposit has accumulated between the stems of the *Salix*, *Betula* and *Populus* seedlings, forming a miniature levee, through the action of which the land lying behind has been elevated and drained, thus forming a wet bottom. In other places the river, during the spring, has taken complete possession of both wet and dry bottom, and in consequence, during summer and fall, the upper zone of the river shore extends to the natural or artificial levee. Where this is the case there ordinarily remains some shrubbery along the base of the levee. Prominent here is usually *Equisetum robustum*. *Eragrostis reptans* covers the banks and its dried stems and leaves are the most striking winter feature.

Islands.

In the fall of the year, with the lowering of the river level, the sandbars are enabled to support a vegetation which does not differ materially from that of the river shore. Conditions here are very much as depicted by Cowles* for the Illinois River. Young specimens of *Salix longifolia*, *Betula nigra* and *Populus monilifera*, together with *Juncus nodosus megacephalus* and *J. tenuis*, *Cyperus diandrus* and *C. strigosus*, are the plants principally found here. *Nasturtium obtusum* and *N. palustre* as well as *Ambrosia trifida* and *Chenopodium ambrosioides anthelminticum* are among the first to make their appearance. Where the island rises so as to offer a permanent foothold (plate 11), *Salix longifolia* is dominant, forming a dense thicket. Associated with it are *S. cordata* × *sericea* and *S. nigra*, *Betula nigra*, *Populus monilifera*, *Prunus serotina*, *Sambucus canadensis* and several herbaceous species which include, besides those just mentioned, *Desmodium Dillenii* and *D. paniculatum*, *Datura Stramonium* and *D. Tatula*, *Solanum nigrum*, *Cyperus aristatus*, *C. Schweinitzii* and *C. speciosus*. Plants of *Riccia natans* are numerous.

Mudflats.

The shifting accretions of silt, chiefly on the Illinois side, support, at low water, a vegetation similar to that of the shore

* Cowles, H. C. The Physiographic Ecology of Chicago and Vicinity; a Study of the Origin, Development and Classification of Plant Societies. Bot. Gaz. **31**: 73. 1901.

and river islands. *Salix longifolia* and *Populus monilifera* are represented by numerous seedlings. There is, of course, no spring flora. Plants ordinarily occur as isolated individuals. There appears to be a greater number of species here than on the islands. Among the plants encountered are *Capsella Bursa-pastoris, Cardiospermum Halicacabum, Rotala ramosior, Jussieua repens, Ambrosia trifida, Bidens cernua, B. chrysanthemoides, B. connata, Erigeron annuus, E. canadensis, E. strigosus, Eupatorium purpureum, E. serotinum, Helenium autumnale, Iva ciliata, Pluchea camphorata, Datura Stramonium, D. Tatula, Solanum carolinense, S. nigrum, Gratiola sphaerocarpa, G. virginiana, Mimulus alatus, Veronica peregrina, Lippia lanceolata, Acnida tuberculata, Euphorbia humistrata, E. Preslii, Polygonum Hydropiper, P. hydropiperoides, Cyperus aristatus, C. diandrus, Diplachne fascicularis, Eragrostis reptans* and *Paspalum fluitans*. This flora disappears with the advent of the high water and all seed is washed away. Since the position of the mudflats is continually changing, it is clear that for a fresh supply of seed an external source must be relied on. While several of the plants bear seeds which are fitted for transportation by wind, it is probable that the seed of many of these species as well as of others is derived from the debris brought down each spring in large quantities.

The Illinois shore.

The sandy shore on this side supports but a scant vegetation. *Salix longifolia* and *Populus monilifera* are never absent. Different herbaceous plants are added during the year. Characteristic are *Oenothera biennis, Xanthium canadense* and *Plantago patagonica aristata. Polygonum aviculare* and *P. erectum* make their appearance as do *Cyperus acuminatus, C. aristatus, C. diandrus, C. Schweinitzii, C. speciosus* and *C. strigosus*. Less important though still fairly numerous are *Nasturtium obtusum, N. palustre, Linum usitatissimum, Geranium carolinianum, Desmodium cuspidatum, D. Dillenii* and *D. paniculatum, Trifolium hybridum* and *Verbascum Thapsus*. Compositae are prominent in the latter part of the year. The most important are *Artemisia ludoviciana, Bidens connata, Coreopsis aristosa* and *C. aristosa mutica,*

Eupatorium purpureum and *E. serotinum.* There occur occasional specimens of *Datura Stramonium* and *D. Tatula, Solanum carolinense* and *S. nigrum.* In places *Chenopodium ambrosioides* and *C. ambrosioides anthelminticum* take complete possession. *Equisetum laevigatum* is not frequent. *Aristida oligantha* and *Sporobolus vaginaeflorus* appear in the latter part of the year.

THE ILLINOIS BOTTOM.

The dry bottom.

That portion of the Illinois bottom usually designated as "dry" bottom and possessing a sandy soil, supports a rich and greatly diversified flora, in sharp contrast with the drier and higher portions of the Mississippi bottom in St. Louis county, where the soil is a heavy clay.

The spring flora is rich in Ranunculaceae, such as *Anemone pennsylvanica, Myosurus minimus, Ranunculus abortivus, R. repens, R. septentrionalis,* and in Cruciferae. *Capsella Bursa-pastoris, Dentaria laciniata, Draba brachycarpa* and *D. caroliniana, Nasturtium sinuatum, Sisymbrium canescens* and *S. officinale, Cerastium arvense, C. arvense oblongifolius,* and *C. nutans* are everywhere, as are rosettes of *Geranium carolinianum* and *Oxalis stricta.* Among the Umbelliferae *Chaerophyllum procumbens* and *Cryptotaenia canadensis* are most frequent at this time. *Sonchus asper* and *S. oleraceus* are everywhere, as are *Verbena stricta* and *V. urticaefolia, Brunella vulgaris* and the local species of *Plantago.* Carices and other Cyperaceae are numerous. The summer adds several Cruciferae as well as Leguminosae, such as *Cassia Chamaecrista, Crotalaria sagittalis, Desmodium canescens, D. ciliare, D. cuspidatum, D. Dillenii, D. paniculatum* and *D. rigidum, Glycyrrhiza lepidota, Lespedeza capitata, L. procumbens, L. violacea, Melilotus alba, M. officinalis, Strophostyles angulosa, S. pauciflora, Trifolium hybridum, T. pratense* and *T. repens,* together with a large number of Compositae. These include *Ambrosia artemisiaefolia, A. bidentata* and *A. trifida, Aster patens, Bidens bipinnata, Erigeron canadensis, E. philadelphicus* and *E. strigosus, Helianthus annuus, H. tuberosus, Solidago canadensis, S. serotina* and several others. The Compositae

are predominant during the autumn. Where there are woodlands, *Quercus coccinea tinctoria*, *Q. imbricaria*, *Q. macrocarpa* and *Q. Muhlenbergii*, together with *Acer dasycarpum* and *Ulmus fulva*, are the species principally encountered.

The wet bottom.

This can be compared directly with the similar region on the Missouri side of the Mississippi, though it is much broader, and, like the dry bottom just mentioned, has been converted almost entirely to agricultural purposes. Here and there remain patches sufficiently large to give an idea of the original flora. This original flora consisted largely of trees and shrubs, the formation being frequently interrupted by sloughs, lakes and swamps. There seem to have been two principal zones. The one, bordering the river and forming a strip of variable width, ordinarily averaging one-half mile, was, and still is, covered by a growth of willows among which *Salix longifolia* is predominant (plates 11, 16). The remainder of the wet bottom appears to have been covered with woods. These, for the greater part, have yielded to the axe. Portions of these woods still remaining will be taken up under a separate heading.

To a rich spring flora, among which Ranunculaceae such as *Isopyrum biternatum*, *Myosurus minimus*, *Ranunculus abortivus* and *R. oblongifolius* are the most frequent, with the exception of some Cruciferae, succeeds a luxuriant summer flora, largely consisting of *Hypericum mutilum* and *H. perforatum*, *Abutilon Avicennae*, *Oxalis stricta*, *Amorpha fruticosa*, *Cassia Chamaecrista*, specimens of *Baptisia leucantha* in groups of two or three, *Potentilla norvegica* and *P. rivalis millegrana*, numerous Compositae, *Asclepias incarnata*, *Convolvulus Sepium*, *Ipomoea hederacea*, *I. lacunosa*, *I. pandurata* and *I. purpurea*, *Stachys palustris*, *Datura Stramonium* and *D. Tatula*, *Phytolacca decandra*, *Polygonum acre*, *P. hydropiperoides*, *P. lapathifolium* and *P. Persicaria*, *Rumex maritimus* and *R. crispus*, *Euphorbia glyptosperma*, *E. humistrata* and *Boehmeria cylindrica*. A large number of these persist till autumn, the additions at this time being mainly limited to the Compositae. Here and there occur

clumps of willows, consisting of *Salix amygdaloides*, *S. amygdaloides* × *nigra*, *S. cordata*, *S. longifolia* and *S. nigra*, especially in the lower portions which frequently are submerged. Two points are to be noted, the one that species of *Crataegus* occur as isolated individuals which in some cases are the only representatives of the species,* and the other that the Mississippi River appears to act as a barrier to their distribution as pointed out by Sargent,† many of the species not being found in Missouri. This same point is illustrated by *Gleditschia aquatica*, specimens of which are not infrequent in the American Bottom opposite St. Louis, but which is not found in St. Louis county, though it appears on the Missouri side opposite Alton, which coincides with the change in physiography, since here the Illinois bluffs overhang the river while on the Missouri side there are vast bottom lands.

The wooded bottom.

The wooded bottom is mainly covered by *Carya amara* and *C. olivaeformis*, *Quercus bicolor*, *Q. macrocarpa*, *Q. palustris*, *Gleditschia triacanthos*, *Gymnocladus canadensis*, *Populus monilifera*, *Celtis mississippiensis* and *Celtis occidentalis*, though *Betula nigra* and *Ulmus americana* are not infrequent. The trees are placed close together, and except at the edges, few other species occur. Grapevines are most numerous, including *Ampelopsis quinquefolia*, *Vitis cinerea*, *V. cordifolia*, and *V. riparia*. The spring flora is limited to *Ranunculus abortivus*, *Capsella Bursa-pastoris*, *Claytonia virginica*, *Arisaema Dracontium* and *A. triphyllum*, *Sagittaria variabilis*, *Alisma Plantago*, *Carex granularis* and *C. laxiflora*. During the early part of the year rosettes of *Lactuca ludoviciana*, *Lobelia cardinalis* and *L. syphilitica* develop. *Lobelia cardinalis* is the most striking plant in the fall of the year, producing immense spikes 6–8 feet in height, bearing brilliant red flowers. At this time *Cassia marylandica* is conspicuous. There is an undergrowth of brambles.

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* Sargent, C. S. Manual of the Trees of North America. 1905.

† Sargent, C. S. Crataegus in Missouri. Rept. Mo. Bot. Gard. **19**: 35. 1908.

Sloughs.

The sloughs harbor a number of water-loving plants and are always bordered by herbs accompanied by a few trees and shrubs, of which the principal are *Gleditschia aquatica*, *Gymnocladus canadensis*, *Cephalanthus occidentalis* and *Betula nigra*, with here and there a clump of willows. *Sium cicutaefolium* occupies a place in the water near the bank, slightly in advance of the row of *Typha latifolia* which in many places fringes the banks. Where the water is shallow *Sagittaria variabilis*, *S. variabilis latifolia* and *Alisma Plantago* find a foothold. *Cardamine rhomboidea* and *Saururus cernuus* are frequent. On the wet banks grow *Nasturtium officinale* and *N. palustre*, *Penthorum sedoides*, *Rotala ramosior* and *Ilysanthes riparia*, with *Lippia lanceolata*, several species of *Polygonum* and *Equisetum robustum*. *Jussieua repens* runs out over the water and in places forms an apparent but continuous bank fully 6 feet wide.

Swamps.

Swampy grounds are abundant in the American Bottom, resulting from the partial drainage of some of its numerous lakes. They are ordinarily covered with a growth of willows, chiefly *Salix amygdaloides*, *S. amygdaloides* × *nigra*, *S. longifolia* and *S. nigra*, together with *Acer dasycarpum*, *Quercus bicolor* and *Q. palustris*. The flora is in places shrubby and then composed of *Ilex decidua*, *Gleditschia aquatica*, *Cephalanthus occidentalis* and *Betula nigra*. Herbaceous plants, most of them water-loving, are abundant. The species most frequently encountered in spring are *Ranunculus abortivus*, *Nasturtium palustre*, *N. sessiliflorum*, *Ludwigia palustris*, *Sium cicutaefolium*, *Senecio lobatus*, *Mentha canadensis*, *Scutellaria lateriflora*, *Iris versicolor*, *Acorus Calamus* and sedges. The summer adds to these *Hibiscus lasiocarpus*, *Aster salicifolius*, *Bidens Beckii*, *Solidago lanceolata*, *Lobelia syphilitica*, *L. cardinalis*, *Heliotropium indicum*, *Lycopus sinuatus* and *L. virginicus*, *Polygonum Hydropiper*, *P. hydropiperoides*, and *P. Muhlenbergii*. At this time *Isoetes mela-*

nopoda may sometimes be found. Other, rarer, species were found here by Dr. Engelmann. The fall aspect does not differ greatly from the summer aspect. Ranunculaceae and Cruciferae disappear as do the various sedges. On the other hand *Aster salicifolius* and *Lobelia cardinalis* at this time reach their greatest development.

Lakes.

So ample an account has been given of the lakes of the American Bottom by Coulter* that it is unnecessary to describe them here. It will suffice to point out some of the differences existing between the typical lowland lakes and those close to the bluff. The former are for the greater part open, while most of the latter are surrounded by a dense growth of trees, largely composed of *Tilia americana, Acer dasycarpum, Aesculus glabra, Gleditschia triacanthos, Morus rubra, Ulmus americana, Ulmus fulva, Betula nigra, Quercus bicolor, Q. macrocarpa, Q. Muhlenbergii* and *Q. rubra, Populus monilifera* and species of *Salix*. In places there is a dense undergrowth of *Euonymus atropurpureus, Sambucus canadensis* and *Cephalanthus occidentalis*, accompanied by *Vitis cinerea* and *V. cordifolia, Rosa setigera* and *Rubus villosus*. Here and there are open places where besides the *Hibiscus lasiocarpus* of the lowland lakes, *H. militaris* also occurs, forming isolated clumps. Among the herbs found near the bluff lake are *Agrimonia Eupatoria* and *A. parviflora*. *Lobelia cardinalis* properly belongs here, as do *Aristolochia tomentosa* and *Asarum canadense*, both from the lower hillside. Species of *Potamogeton* appear to be more frequent in the lowland lakes, but the bluff lakes harbor more specimens of *Eleocharis*. *Nuphar advena minus*, not found in the lowland lakes, where *Nymphaea odorata* occurs, is found in the bluff lakes. Here *Nelumbium luteum*, though sometimes found, is not so marked a feature (plate 20).

THE RAILROAD.

The main difference between the railroad right of way in Illinois and that in the Missouri portion of the section studied lies in the fact that while the latter is situated close to the

* *loc. cit.*

bluff and in a comparatively dry situation, the former passes through the lowland at a distance from the hills. Besides, the railroads tap entirely different sections of the country and consequently one finds differences in the species of introduced plants, to be considered under a special heading.

The main roadside aspect is given by grasses, chiefly *Poa pratensis*, with which *Agropyrum repens*, *Agrostis alba* and several other grasses are associated. The spring brings with it such species as *Myosurus minimus*, *Corydalis aurea*, *Capsella Bursa-pastoris*, *Lepidium intermedium*, *Nasturtium obtusum*, *Sisymbrium altissimum*, *S. canescens*, *S. officinale*, *Tribulus grandiflorus*, various clovers, *Mollugo verticillata*, *Plantago lanceolata*, *P. patagonica aristata*, *P. Rugelii* and *P. virginica*. Rosettes of *Oenothera biennis*, *Stellaria media*, *Lactuca Scariola*, *L. Scariola integrata* and *Verbascum Thapsus* are encountered from time to time. The occurrence of *Lilium canadense* is to be noted. The summer adds *Portulaca oleracea*, *Bergia texana* (rare), several Leguminosae, such as *Cassia Chamaecrista*, *Dalea alopecuroides*, *Desmodium canescens*, *Medicago sativa*, *Melilotus alba* and *M. officinalis*, as well as a number of Compositae, mainly *Ambrosia psilostachya*, *A. trifida*, *Helianthus annuus* and *H. grosse-serratus*, which in some places takes entire possession, *Solanum carolinense*, *Amaranthus albus*, *A. blitoides* and *A. retroflexus*, *Croton capitatus*, *Euphorbia humistrata*, *Setaria glauca*, *S. italica* and *S. viridis*, with here and there specimens of *Zea Mays*. The autumn sees some additions, mainly from the Compositae, and at this time too patches of *Linaria vulgaris* attract attention, as does the Russian thistle, *Salsola Kali Tragus*.

In the American Bottom there is ordinarily no bank enclosing the railroad as there is along the Missouri bluffs, fences separating it from the adjacent cultivated fields. Along these fences hedges frequently are formed, composed of brambles, together with *Cassia Chamaecrista*, *Tecoma radicans*, and *Rhus Toxicodendron*, among which *Ulmus americana* is not infrequent. The railroad ponds do not offer features distinct from those on the Missouri side, except for the occurrence of *Nelumbium luteum*, *Utricularia biflora* and *Echinodorus radicans*.

While the embankment is ordinarily kept free from plant growth and the conditions themselves do not favor vegetation, rosettes and isolated individuals of species occurring along the railroad right of way are found from time to time growing in the ballast.

THE ILLINOIS BLUFF.

Talus.

The talus at the foot of the Illinois bluffs presents the same general aspect as does that on the Missouri side of the section studied. It differs, however, in details, and for various reasons. Though both are at the base of limestone bluffs, the exposure is diametrically opposite. Though one would expect to find as a result that the flora on the Missouri talus was richer in species, the opposite is the case. Plants distributed by railroads are less important on the Illinois talus since this is partially skirted by a local line only.

The principal plants occurring on the Illinois talus but lacking in the corresponding locality in Missouri are *Stylophorum diphyllum, Arabis confinis, Viola striata, Hypericum Ascyron, Epilobium coloratum, Osmorrhiza longistylis, Bidens connata, Vernonia altissima, Phacelia bipinnatifida, P. Purshii, Euphorbia obtusata* and *Habenaria virescens*. But for the presence of these plants there is no difference between the talus on either side. It is to be noted, however, that large springs, notably Falling Spring, issue from the face of the Illinois bluff, permitting the existence of numerous liverworts and algae. The occurrence of *Chlorotylium mamillosum*, which covers the rocks at Falling Spring with a green felt, is to be noted here.

The cliff.

Like the talus, the cliff surface above it shows certain differences when compared with that of the Missouri bluffs. Frequently the shrubs reach up to the top of the bluff. This is well shown by the occurrence, in the upper part, of *Delphinium tricorne* and *Arabis laevigata*, plants which on the Missouri side are limited to the more shaded localities. However, in such portions as are exposed, the flora presents a

rosette formation not differing materially from that on the Missouri side.

THE ILLINOIS PLATEAU.

The wooded area.

The woods of the Illinois plateau, composed mainly of deciduous oaks, resemble generally those of the Missouri plateau. They appear to be somewhat richer in species. On the whole they seem to be moister. *Hepatica acutiloba*, seldom encountered near Jefferson Barracks, though plentiful at Meramec Highlands, is frequently met with in the Illinois woods. The same is true for *Anemone pennsylvanica*, curiously enough known only from the dry bottom on the Missouri side. *Gentiana Andrewsii* thus far has not been found near Jefferson Barracks.

Open hillside.

This supports but little shrubbery, which, if occurring at all, is composed mainly of *Rhus glabra*. Grasses are dominant, *Poa pratensis* being the principal species. It is accompanied by *Agrostis scabra*, *Andropogon furcatus*, *A. scoparius*, *Aristida oligantha*, *Bromus secalinus*, *Danthonia spicata*, *Eatonia obtusata*, *Festuca tenella*, *Muhlenbergia sobolifera*, *Panicum sanguinale*, *Phleum pratense*, *Poa annua*, and *Vilfa aspera*. During the spring a number of low growing plants occur, such as *Ranunculus fascicularis*, *Capsella Bursa-pastoris*, *Lepidium virginicum*, *Viola Rafinesquii*, *Malva rotundifolia*, *Linum virginianum*, *Fragaria virginiana*, rosettes of *Oenothera biennis* and of various Compositae, of which, at this time, *Achillea Millefolium* and *Antennaria plantaginifolia*, are most frequent, and further, *Androsace occidentalis*, *Verbena angustifolia*, *V. bracteosa* and *V. urticaefolia*, *Comandra umbellata*, *Rumex Acetosella* and *Hypoxis erecta*. Later are added *Abutilon Avicennae*, *Linum sulcatum*, numerous Leguminosae, *Gaura biennis*, species of *Aster* and *Solidago*, *Gerardia tenuifolia*, *Monarda punctata*, *Croton capitatus* and *C. monanthogynus*.

Creek banks.

The greater portion of the Illinois plateau having been brought into cultivation, the presence of a small stream is at

once patent to the eye on account of the numerous trees and shrubs which line its banks. The principal trees are *Tilia americana, Acer dasycarpum, A. rubrum, A. saccharinum, Negundo aceroides, Cercis canadensis, Gleditschia triacanthos, Gymnocladus canadensis, Fraxinus americana, F. viridis, Celtis occidentalis, Morus rubra, Ulmus americana, Platanus occidentalis, Carya amara, C. olivaeformis, Betula nigra, Carpinus caroliniana, Quercus macrocarpa, Salix cordata* × *sericea* and *Salix nigra.* Smaller trees and shrubs occurring here are *Asimina triloba, Ptelea trifoliata, Rhamnus lanceolata, Staphylea trifolia, Amelanchier canadensis, Prunus americana, P. serotina* and *P. virginiana, Pyrus coronaria, Hydrangea arborescens, Cornus asperifolia, C. paniculata, Sambucus canadensis, Symphoricarpus vulgaris, Viburnum Lentago, Forestiera acuminata, Corylus americana* and *Celtis mississippiensis.* Vines are numerous, especially *Ampelopsis quinquefolia, Cissus Ampelopsis, Vitis cinerea, V. cordifolia,* and *V. riparia* as well as *Rhus Toxicodendron. Menispermum canadense, Convolvulus Sepium* and *Ipomoea pandurata* are frequently encountered. *Clematis virginiana* is not rare. Near the water *Echinocystis lobata* and *Sicyos angulatus* occur in places.

In spring there is developed an abundant rosette flora chiefly composed of Ranunculaceae and Liliaceae. *Anemonella thalictroides, Isopyrum biternatum, Ranunculus abortivus* and *R. septentrionalis, Thalictrum purpurascens, Podophyllum peltatum, Sanguinaria canadensis, Dicentra Cucullaria, Sanicula marylandica canadensis, Trillium recurvatum, T. sessile* and *Uvularia perfoliata* are the most common. *Arisaema Dracontium* and *A. triphyllum* are everywhere. Among the Carices, *C. Davisii, C. granularis, C. laxiflora* and *C. Shortiana* are the most frequent. *Cyperus erythrorhizos* and *Poa pratensis* are everywhere at this time. Of ferns, the principal ones are *Adiantum pedatum* and *Cystopteris fragilis.* While early summer does not make any great changes in the vegetation, there is a gradual change with the seasons so that in late summer and early fall one finds that Compositae and Labiatae have taken possession.

The prairie.

The prairie flora on the Illinois side does not differ materially from that on the Missouri plateau. In spring a number of grasses make their appearance, especially *Agrostis alba*, *A. scabra*, *Danthonia spicata*, *Elymus striatus*, *Phleum pratense* and *Poa pratensis*. Rosette-forming species appear along with these. *Capsella Bursa-pastoris*, *Sisymbrium officinale*, *Oenothera biennis*, *Erigeron annuus*, *E. canadensis* and *E. philadelphicus*, *Taraxacum officinale*, *Veronica arvensis*, *Verbena stricta* and *V. urticaefolia* are among the most frequent and most striking. Other species appearing at this time are *Anemonella thalictroides*, *Ranunculus fascicularis*, *Draba caroliniana*, *Geranium carolinianum*, *Oxalis stricta*, *Polygala verticillata*, *Amorpha canescens*, *Astragalus mexicanus*, *Stylosanthes elatior*, *Triosteum angustifolium* and *T. perfoliatum*, *Houstonia angustifolia*, *Chrysopsis villosa*, *Parthenium integrifolium*, *Silphium integrifolium*, and *Phlox pilosa*. These practically form the spring flora together with those plants whose rosettes have been striking features during the winter months. Among them *Lechea major* and *L. minor*, *Achillea Millefolium*, *Cnicus pumilus* and *Plantago Rugelii* are to be noted especially. Nor should mention of the presence of clumps of *Opuntia Rafinesquii* and of *Monarda fistulosa* be omitted.

The summer sees a large addition to the species above mentioned, the new species being derived especially from the Leguminosae and Compositae as shown by the distribution tables. During the autumn Compositae are most prominent, especially several species of *Aster* and *Solidago*.

Introduced Plants.

The introduced plants are found chiefly in three localities, *i.e.*, in the vicinity of dwellings, in parks and nurseries, and on the railroad right of way. Among the railroad immigrants must be placed the following: *Clematis crispa* (S. U. S.), *Argemone alba* (W. and S. W. U. S.), *Argemone platyceras* (W. and S. W. U. S.), *Sisymbrium altissimum* (S. U. S.), *Cleome integrifolia* (W. U. S.), *Polanisia graveolens* (brought to the

railroad rights of way along the Mississippi, both in St. Louis county and in the Illinois section, with railroad ballast obtained from the Meramec River gravel bars), *Bergia texana* (W. U. S.), *Tribulus grandiflorus* (S. E. U. S.), *Indigofera leptosepala* (S. U. S.), *Petalostemon villosus* (W. U. S.), *Medicago lupulina* (E. U. S.), *Matricaria discoidea* (N. California and Oregon), *Verbesina encelioides* (W. U. S.), *Linaria vulgaris* (E. U. S.) and *Sorghum halepense* (E. U. S.).

Three plants are to be listed as "river immigrants." They are *Pluchea camphorata* (E. U. S.), *Martynia proboscidea* (W. U. S.) and *Verbesina encelioides* (W. U. S.), already mentioned as a railroad immigrant.

In regard to the acclimatized cultivated plants, *Brassica alba* and *B. nigra*, as well as *Nasturtium officinale* and *N. Armoracia*, *Raphanus sativus*, *Pastinaca sativa*, *Cichorium Intybus*, and *Asparagus officinalis*, are plants of the kitchen-garden and usually found around dwellings, though some, like *Brassica alba*, *B. nigra* and *Asparagus officinalis*, may be found at a considerable distance from human habitations. *Delphinium Ajacis*, *Saponaria officinalis* and *Hemerocallis fulva* are escaped ornamental garden plants. The latter species is found in great abundance along roadsides in the vicinity of Jefferson Barracks. *Lamium amplexicaule*, one of the earliest weeds to flower here, is found especially near greenhouses, lasting almost throughout the year. Another plant, similarly limited to the vicinity of greenhouses, but which thus far has been found only in the city of St, Louis, is *Galinsoga parviflora;* it may become a troublesome weed. *Ballota nigra* is found here and there in waste places. *Prunus Persica* is especially abundant on the plateau at Jefferson Barracks, bordering the roads and foot paths. *Ailanthus glandulosus*, *Robinia hispida* and *R. Pseudacacia* are trees which easily spread in the vicinity of dwellings. The effect of wind upon distribution is well shown in the case of the latter species. The escape of the various plants used as cattle food is too well know to discuss further. Neither need it be pointed out that the various aromatic plants used as condiments and commonly grown in kitchen-gardens have escaped in the vicinity of dwellings, though it may be of inter-

est to note that such escapes are most frequent in the vicinity of dwellings occupied by people of German origin. Such plants are *Coriandrum sativum, Foeniculum officinale, Marrubium vulgare, Melissa officinalis* and *Nepeta Cataria. Fagopyrum esculentum* and *Cannabis sativa* frequently are found in waste places where they maintain themselves against great odds. *Cichorium Intybus* which, according to Pammel*, was introduced near Dorchester, Mass. in 1875 and since then has spread chiefly through the northern states, is frequent along the roadsides on the Illinois plateau, an evident escape from cultivation. As transient garden escapes are to be considered *Nymphaea reniformis, Citrullus vulgaris, Citrullus ovifera pyriformis, Centaurea Cyanus, Coreopsis tinctoria, Matricaria Chamomilla, Nicandra physaloides* and *Zea Mays.*

The transient weeds are *Argemone alba, Argemone platyceras, Camelina sativa, Sisymbrium altissimum, Cleome integrifolia, Hibiscus Trionum, Medicago lupulina, Petalostemon villosus, Pluchea camphorata, Martynia proboscidea* and *Phalaris canariensis.* Naturally there are a number of other plants which from time to time are introduced through the agency of man, especially among nursery stock. Such plants are most frequently met with in parks and nurseries but are not of sufficiently frequent occurrence to attract attention, the number of individuals being limited. An exception to this rule proved one of the Cyanophyceae, determined by Professor W. A. Setchell as *Oscillatoria Agardhii*,† and new to North America, specimens of which occurred in so large quantities in one of the ponds of the Missouri Botanical Garden, as to form a water bloom. The pond in which these plants were found communicates by a drain with the ponds of Tower Grove Park and it is more than probable that the plant was introduced with water lilies obtained for the park from eastern dealers who imported European stock.

The introduced established weeds include *Clematis crispa, Delphinium Consolida, Chelidonium majus, Sisymbrium of-*

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* Pammel, L. H. Ecology. 335. 1903.

† Collins, F. S., I. Holden and W. A. Setchell. Phyc. Bor. Amer. **30:** 1451. 1908.

ficinale, Polanisia graveolens, Lychnis Githago, Silene media, Abutilon Avicennae, Tribulus grandiflorus, Dalea alopecuroides, Glycyrrhiza lepidota, Indigofera leptosepala, Melilotus alba, Melilotus officinalis, Daucus Carota, Dipsacus sylvestris, Chrysanthemum Leucanthemum, Lactuca Scariola, L. Scariola integrata, Matricaria discoidea, Verbesina encelioides, Linaria vulgaris, Solanum rostratum, Ballota nigra, Lamium amplexicaule, Leonurus Cardiaca, Alopecurus geniculatus, Bromus secalinus, Dactylis glomerata, Eleusine indica, Hordeum jubatum, Panicum sanguinale, Poa annua, Poa compressa, Poa pratensis, Setaria glauca, Setaria italica, Setaria viridis and *Sorghum halepense.* It is probable that seed of each of these species was introduced repeatedly, of some more recently, of others earlier. Among the latter must be classed *Lactuca Scariola integrata,* sometimes designated by American authors as *L. Scariola* and again as *L. virosa.** This entire leaved form, which is entirely distinct from the European *L. virosa,* was introduced into Missouri from Illinois. According to Mr. J. H. Kellogg, it was plentiful in the American Bottom thirty years ago. Some ten years later its occurrence on this side of the Mississippi was noted. Since then it has spread to an enormous extent, being one of the principal weeds of roadsides and empty lots. During the summer of 1907 Dr. Trelease noted the appearance, west of St. Louis, of the cut-leaved form, the true *L. Scariola.* During the same year the plant was found in numerous localities in the vicinity of St. Louis but not in the city itself. This year, 1908, there has been a marked increase in the number of individuals of *Lactuca Scariola* as well as in the number of localities where the plant was encountered. It has also made its appearance on lots well within the city limits.

The plants which have escaped from cultivation and have become established are *Delphinium Ajacis, Brassica alba, B. nigra, Nasturtium Armoracia, N. officinale, Raphanus sativus, Saponaria officinalis, Linum usitatissimum, Ailanthus glandulosus, Medicago sativa, Robinia Pseudacacia, Trifolium hybridum, T. pratense, T. repens, Vicia sativa, Prunus Persica, Coriandrum sativum, Foeniculum officinale,*

* Dewey, L. H. Identity of Prickly Lettuce. Rhodora. 7:9. 1905.

Pastinaca sativa, Cichorium Intybus, Marrubium vulgare, Melissa officinalis, Nepeta Cataria, Fagopyrum esculentum, Cannabis sativa, Humulus Lupulus, Asparagus officinalis, Hemerocallis fulva, Agrostis alba, Avena sativa and *Phleum pratense.*

Phenology.

Geographical position, especially latitude, determines largely the nature of the plant growth and the flowering and fruiting seasons as well as other phenological phenomena.* As shown by De Candolle† by experiments with both herbaceous and woody plants, vegetation is more powerfully or promptly acted upon by the rising spring temperature in

TABLE L.

SPECIES FLOWERING AND FRUITING, BY MONTHS.

MONTH	Flower	Fruit
March	24	0
April	134	0
May	334	50
June	338	141
July	395	223
August	384	341
September	229	437
October	59	262
November	14	45

higher than in lower latitudes. Subordinate, but of greatest local influence, is physiography since indirectly, in determining the nature of the associations, as well as directly, it modifies the temperature and the humidity of air and soil, the air currents, and the intensity and amount of light together with the chemical and physical conditions, including color, of the soil. Each of these factors plays a part in the bringing about of phenological phenomena, though temperature is probably the most important. However, to heat alone the earlier or later date of flowering can not be ascribed. A striking instance is yielded by the agaves of the island Lesina in the Adriatic, which did not flower during 1889, something entirely

* Schwendener, S. U. Ueber die periodischen Erscheinungen der Natur insbesondere der Pflanzenwelt. Zurich. 1856.

† De Candolle, A. Des Effets différents d'une même Température sur une même Espèce au Nord et au Midi. Compt. Rend. **80.** 7 Je. 1875.

unusual and which the temperature conditions would not have led one to expect.* On the other hand, at the Missouri Botanical Garden, it has been observed every spring that in the portion of the tulip beds facing the south, the bulbs placed in the outer row, where the slope of the soil is nearer the perpendicular, always flower several days earlier than do the others.

TABLE M.

FAMILIES	Mr	Ap	My	Je	Jl	Ag	S	O	N
Ranunculaceae	2	11	25	16	7	2	1	0	0
Cruciferae	4	14	20	16	9	5	3	3	1
Leguminosae	1	5	11	28	33	27	10	3	0
Rosaceae	0	14	30	13	9	2	2	0	0
Onagraceae	0	0	2	7	13	10	5	0	0
Umbelliferae	1	4	10	11	10	5	1	0	0
Compositae	0	4	14	19	45	72	69	13	1
Asclepiadaceae	0	0	2	6	9	5	0	0	0
Convolvulaceae	0	0	0	1	6	8	7	0	0
Solanaceae	0	0	1	3	9	7	4	3	0
Scrophularineae	0	3	5	9	8	12	9	1	0
Verbenaceae	0	1	2	7	9	8	5	1	0
Labiatae	1	2	7	11	21	20	9	0	0
Amaranthaceae	0	0	0	2	4	2	3	0	0
Chenopodiaceae	0	0	0	1	5	7	4	1	1
Polygonaceae	0	0	5	7	15	16	8	1	1
Euphorbiaceae	0	0	1	3	9	14	6	3	2
Liliaceae	0	6	9	6	0	0	0	0	0
Cyperaceae	0	4	28	33	25	20	12	3	0
Gramineae	0	1	13	23	25	30	22	10	1

SPECIES OF IMPORTANT FAMILIES IN FLOWER, MARCH TO NOVEMBER.

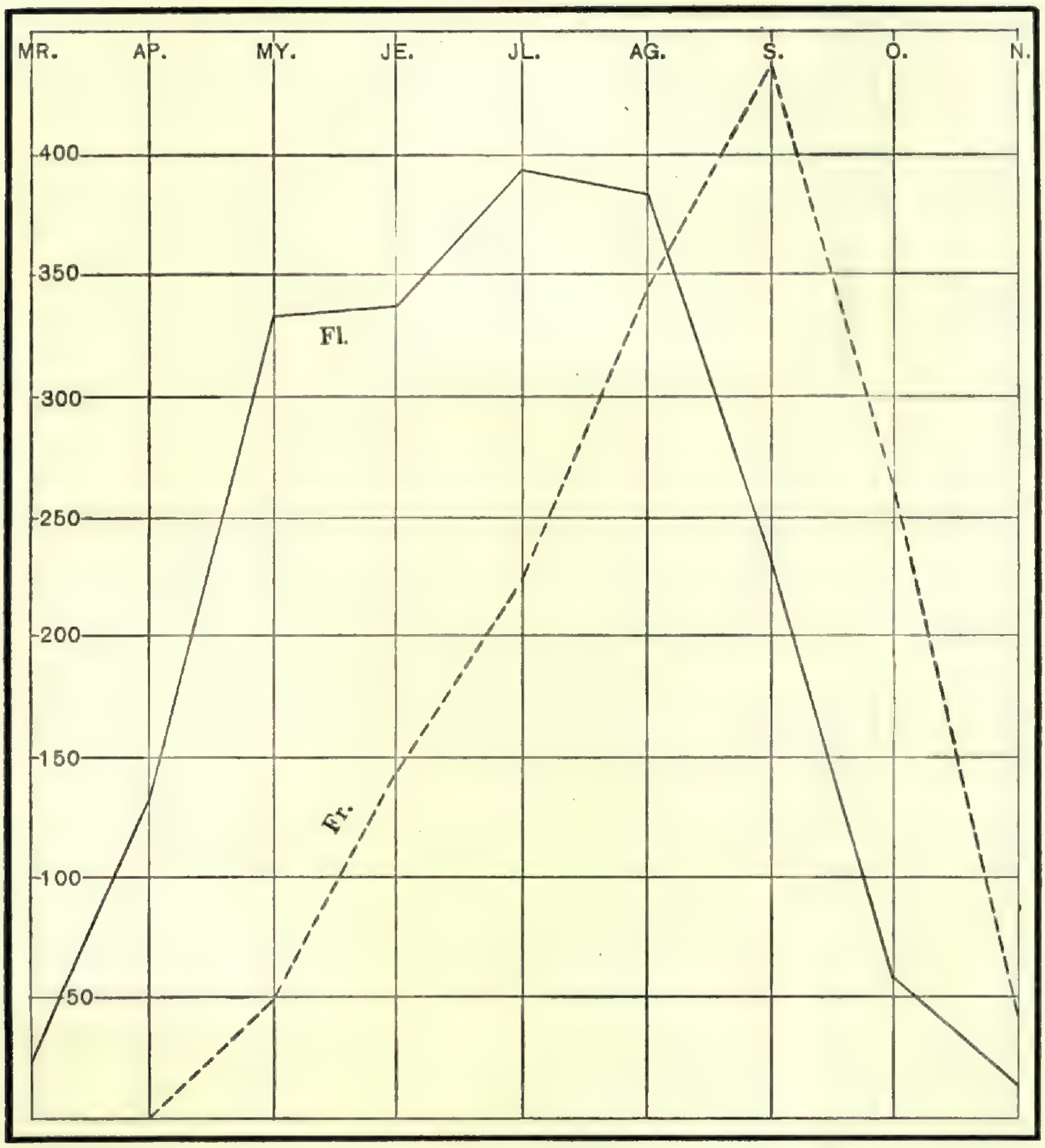
It must be remembered in this connection that tulips, by winter, have formed the next year's leaves and flowers and that this development has advanced so far that even the pollen mother cells have divided. Similar conditions are exhibited by many of the more familiar spring flowering species such as *Anemone Hepatica*, *Sanguinaria canadensis*, *Asarum canadense*, *Arisaema triphyllum* and others.† In such cases the time of flowering evidently depends in a measure on the climatic conditions of the summer and fall preceding as influencing the development of the flower buds. Some,

* Gunther, S. Die Phänologie. Natur und Offenbarung. 41. 1895.

† Foerste, A. F. The Hibernacula of Herbs. Am. Nat. **17**: 1107. 1883.—Why Flowers Blossom Early. Am. Nat. **19**: 301. 1885.

like *Aralia quinquefolia*, even form the bud, which produces the flowering stalk in June or July, two years earlier. Contrary to what one would be led to expect, the flowering period is rather late. Trees respond readily to a greater amount of

DIAGRAM 1.

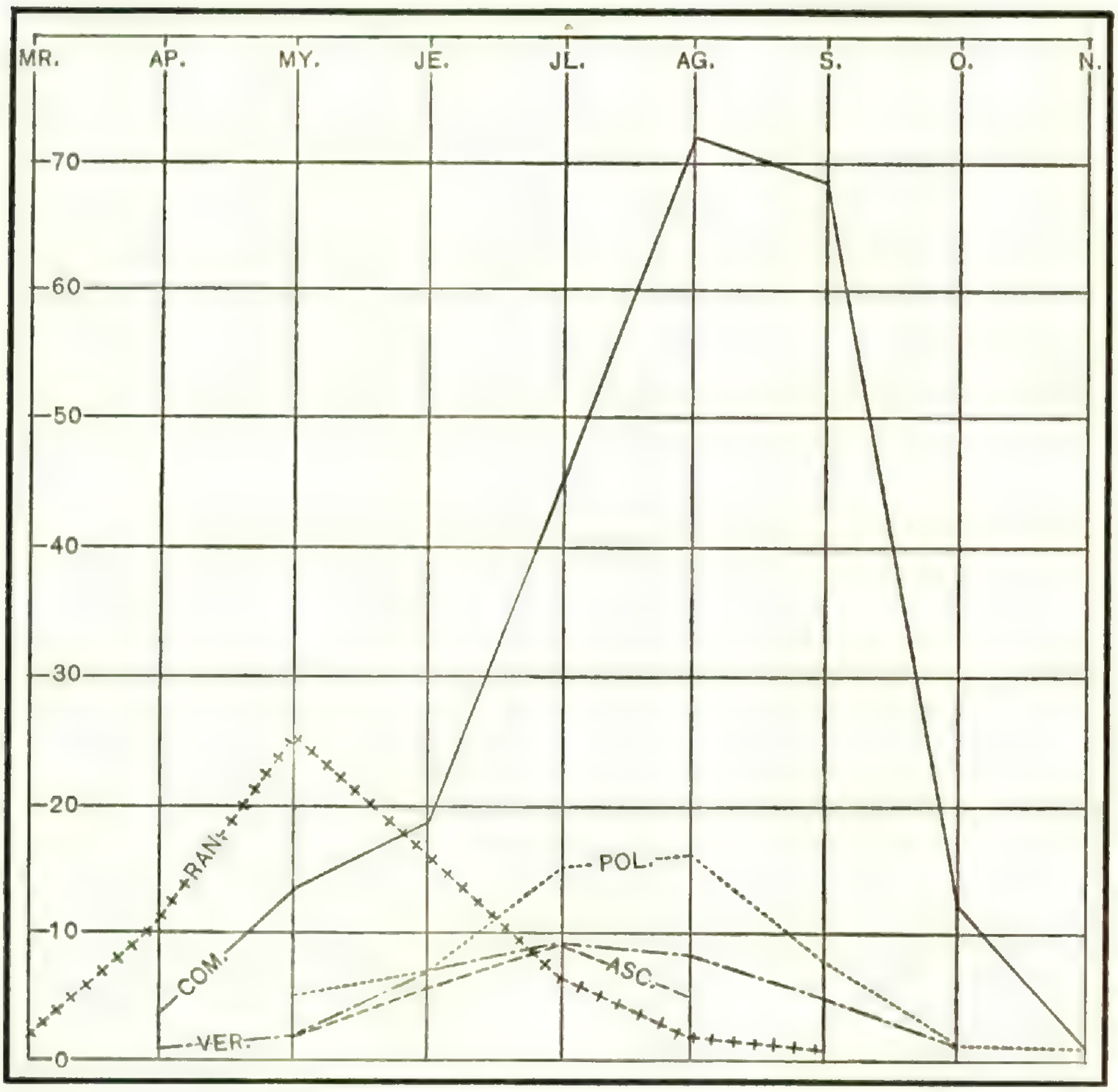


SPECIES FLOWERING AND FRUITING, THROUGH SEASON.

heat. It is a matter of yearly observation that the flower buds of those branches of *Acer* facing the south open as much as two weeks earlier than those which face the north. Similarly, rosettes of biennials and perennials which during the winter have been kept in greenhouses or frames blossom much

earlier than those which have remained outside. To such a cause is ascribed the flowering, in June, of *Lobelia cardinalis*, noted by Mr. Irish.* This seems correlated with the fact that where biennials, such as *Digitalis purpurea*, have been sown so late in the fall that during the next year they pro-

DIAGRAM 2.



FLOWERING OF FAMILIES, THROUGH SEASON.

duced no flowers, they in the spring following will flower very early, the flower stalks being short and the flowers small. This early flowering would by some be ascribed to a large amount of food being stored in the root, by others to the plant having received more than a definite number of heat units,

* Irish, H. C. Comparative Phenological Notes. Rept. Mo. State Hort. Soc. **40**: 325. 1897.

denoted the physiological constant. The same explanation probably holds good for those rosettes of biennials which develop an inflorescence far in advance of others. Observations on *Lactuca Scariola integrata* have shown that the rosettes formed early in the fall were the first to bloom during the following year.

A smaller amount or a lesser intensity of light seem to cause a delay in the appearance of the flower, a matter of common observation in horticultural establishments. It is shown also by the behaviour of representatives of a species occurring both in the open and in the woods, though in the latter case a lower temperature and increased humidity, both of soil and air, play a part. That a greater degree of soil moisture, alone or practically alone, delays the flowering period is shown by a comparison of individuals of the same species in dry situations and in moister surroundings. The wet and the dry portions of the American Bottom yield numerous instances. Drought will cause an early appearance of the flower, a fact well known to florists and made use of by them when preparing potted plants for market.

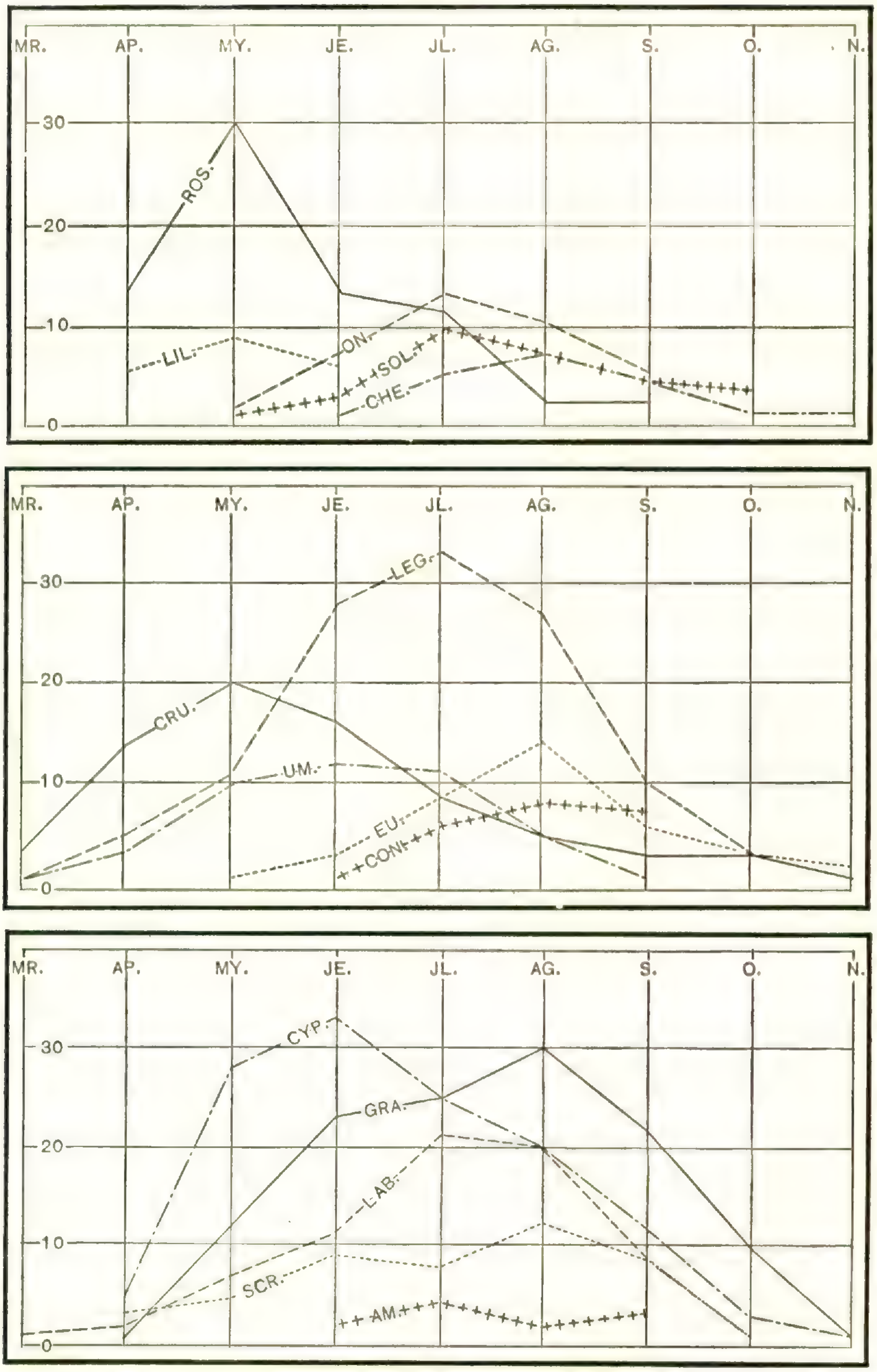
Phenological phenomena further depend on individual characteristics and state of health of the tree or plant and, as shown in the case of fruit trees, but probably applicable to other plants also, on the heavy or light fruiting in the year previous to flowering.* Some plants, under apparently identical conditions, vary greatly in respect to flowering seasons. Specimens of *Hamamelis virginiana*, properly flowering during the autumn, frequently do so in spring, others, in the immediate vicinity, behaving normally. Some will flower even both in fall and spring.

Different species are not influenced to the same extent by changes of temperature, giving rise to cases of inversion, *i. e.* where a species which normally flowers later than another does so earlier.† Again, under proper climatic conditions, plants which in one region are annuals may become peren-

* Sandsten, E. P. Conditions which affect the Time of the annual Flowering of Fruit Trees. Wisconsin Agric. Exp. Sta. Bul. **137**: .7. 1906.

† Rahn, L. Ueber phänologische Inversionen. Ber. Oberhess. Ges. Nat. und Heilk. **21**: 114. 1882.

DIAGRAM 3.



FLOWERING OF FAMILIES, THROUGH SEASON.

nials, as shown by the perennial nature of the tomato and the geranium and *Lantana Camara* in California as contrasted with conditions prevailing at St. Louis.

A comparison of various phenological data leads to the conclusion that as a rule there is little variation, in the different parts of the country, in regard to the appearance of the flowers in the case of those plants which are summer flowering. The early flowering plants show the greatest variation. Conditions in North America are best expressed in the words of Trelease:*

"In a country covering nearly twenty-five degrees of latitude and fifty-five of longitude, with lofty mountains and tablelands and low valleys, diversified by great lakes and rivers, and embracing every variety of climate from the subtropical to the subarctic, with excesses of humidity in one region and of drought in another, it is impossible to arrange the phenomena of the seasons so as to include the whole.

"On comparing the data obtainable, however, a few general features are found common to a great part of the country. Whatever their exact date of leafing or flowering may be, there are certain genera—like the maples, poplars and elms among trees, and the violets and wake robins among herbs—that precede most of their fellows; and, except in very anomalous seasons, their species succeed each other with the same regularity. Where the same plant extends from the Gulf to New England, it naturally blooms earlier in the warmer region; but it is noticeable that the difference, greatest in the flowers of early spring, becomes less marked as the season advances, under the accelerating heat of the northern summer, so that there is often little difference in the flowering of summer and autumnal plants. In general the same rule applies to species occurring over a considerable range of altitude, and is now and then illustrated nicely by a species with a wide distribution on both high and low ground."

From the above will be gathered the desirability of the making of a large number of accurate observations such as

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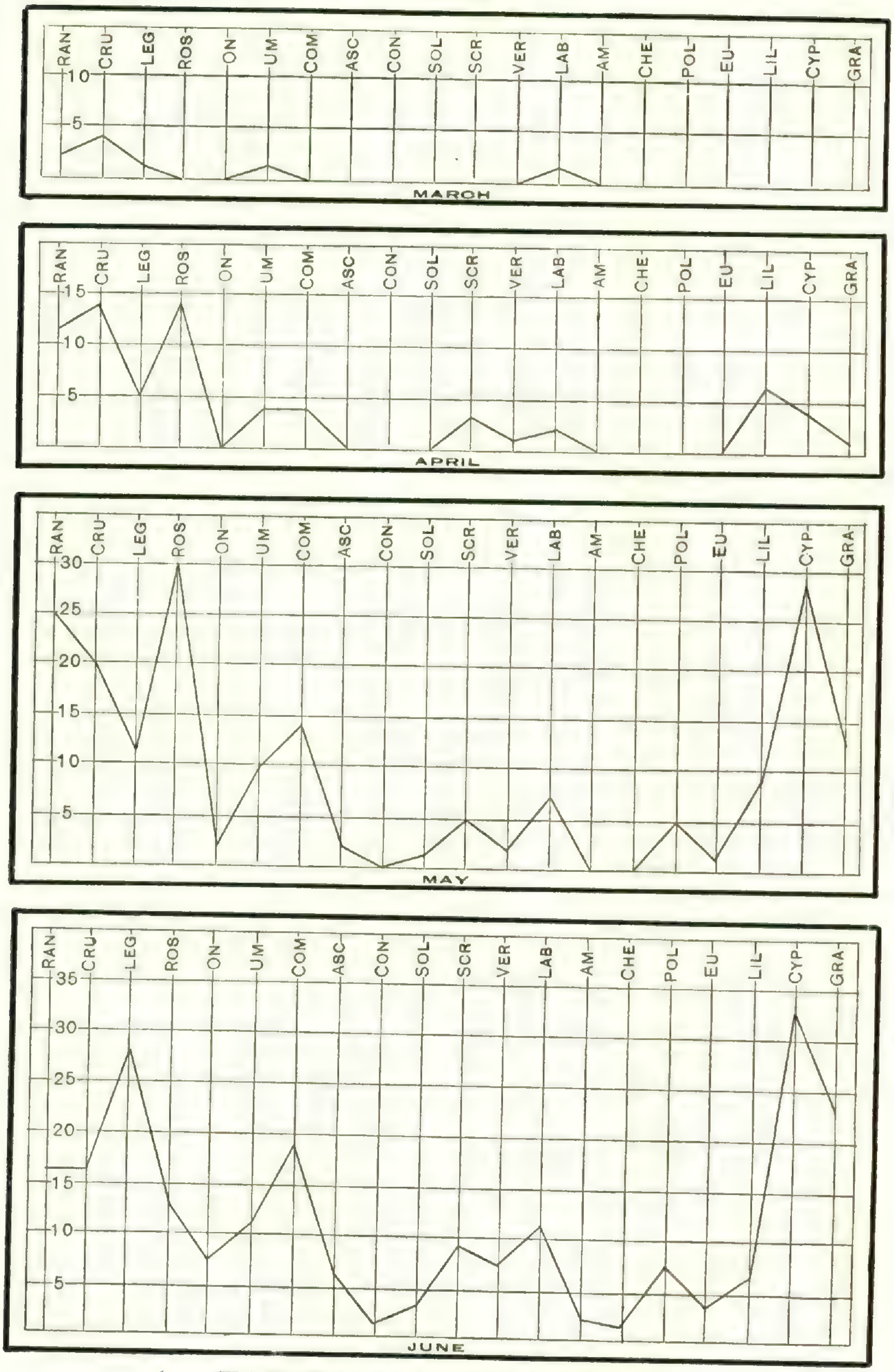
* Trelease, W. Blooming Times for Flowers. Science Almanac. 5. 1885.

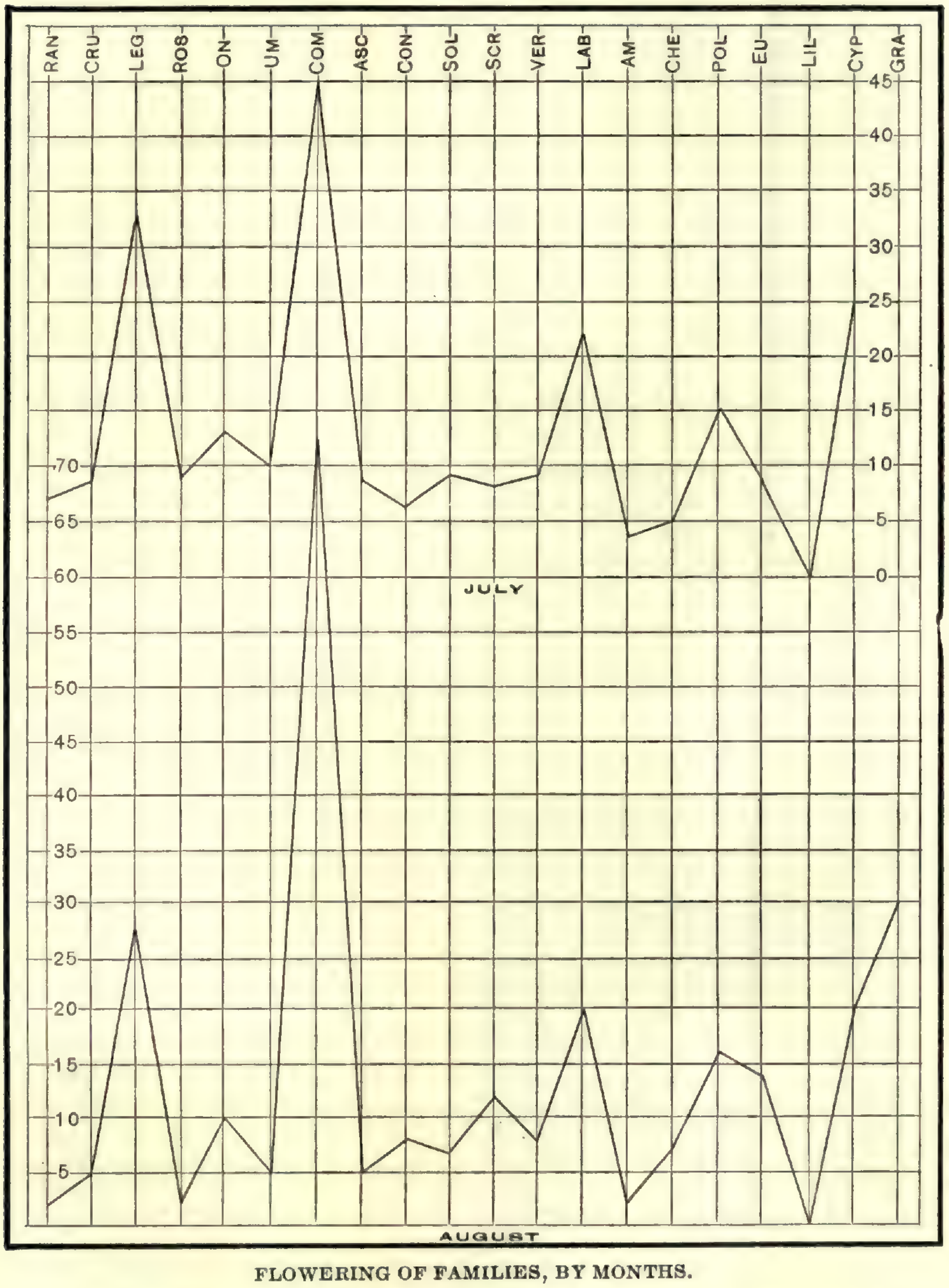
DIAGRAM 4.



FLOWERING OF FAMILIES, BY MONTHS.

those of Craig,* but on a larger scale and in every part of the country, together with observations on light intensity based

DIAGRAM 5.



FLOWERING OF FAMILIES, BY MONTHS.

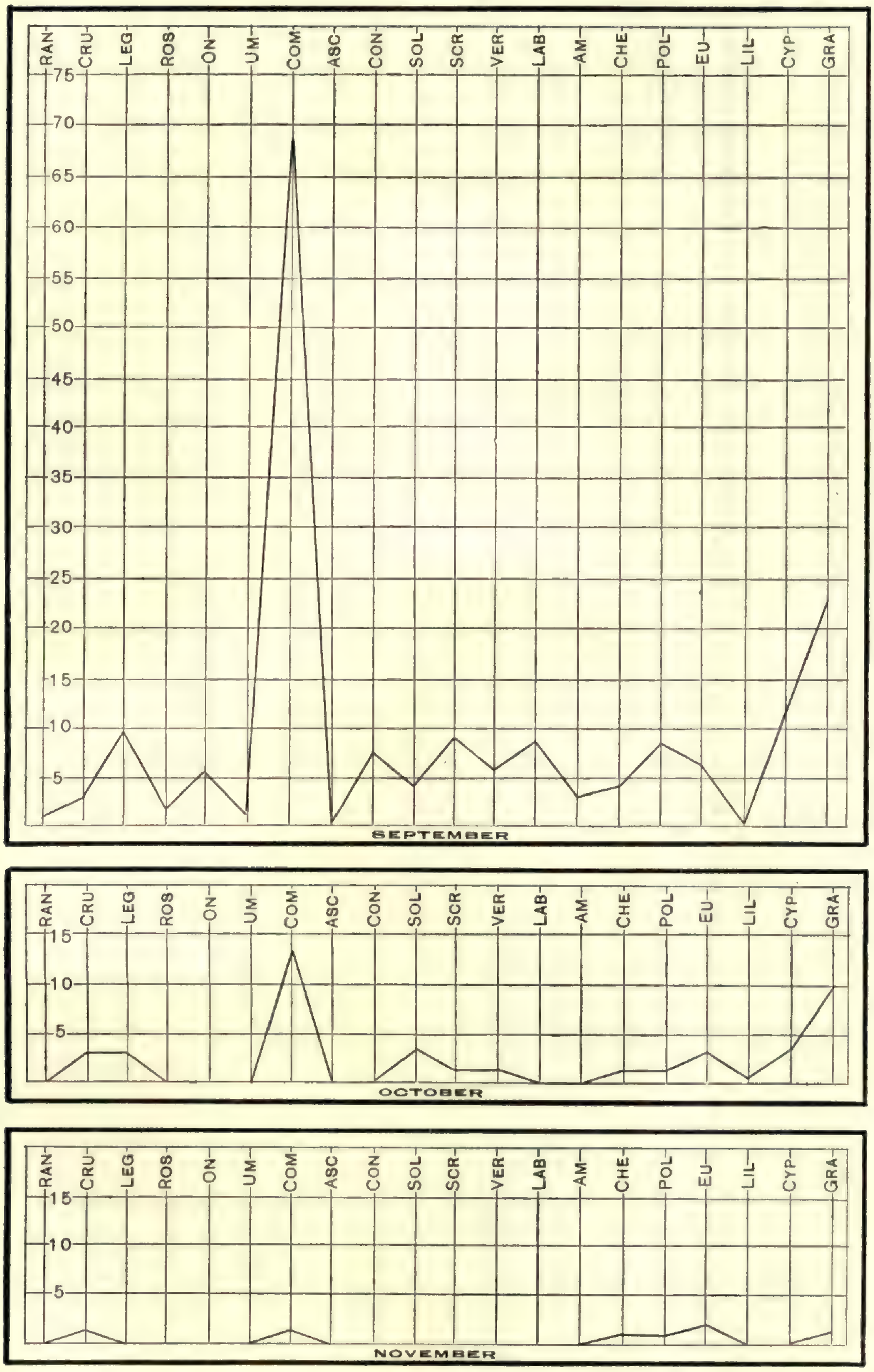
on a uniform standard, and, where not already provided for,

* Craig, M. A Catalogue of the uncultivated Flowering Plants growing on the Ohio State University Grounds. Ohio Agric. Exp. Sta. Bull. tech. ser. 1^2:49. 1890.

the usual meteorological observations. Such attempts have been made from time to time in the United States, but nowhere appears to have been attained that perfection shown by the data gathered under the auspices of the Botanical Club of Canada, for a great part by pupils of public schools, or those published by the forest-phenological stations of Germany.

In regard to the plants enumerated in the distribution and phenological tables following, a few points are to be noted here. Some never set fruit, as *Nasturtium Armoracia* and *Apios tuberosa*. Others, and this applies to the most common weeds, appear with varying frequency in successive years. *Portulaca oleracea* is very plentiful during the present year as it was in 1906 while during 1907 it was far less of a pest. Opposed to this is *Ellisea Nyctelea* which was very plentiful in 1907, covering large patches to the exclusion of all other species. While both in 1906 and in the spring of the present year a large number of plants of this species were observed, the species was by far not so abundant as during the intervening year. Interesting is in this connection the appearance of *Commelina communis* at St. Louis, this being the first time it has been reported from this locality. The writer first noticed the plant in his seedpans in large numbers in the spring of 1908. During the previous years this had not been the case, probably because only isolated individuals appeared. Later in the season the plant was found as a common weed in various parts of the Missouri Botanical Garden. Its identity with similar plants which, in lesser numbers, had occurred the previous year was established through some plants raised from seed obtained in one of the localities during 1907. If the occurrence of the plant had been limited to the Missouri Botanical Garden the explanation that there it had escaped from cultivation would probably have been accepted as valid. But during the spring and summer of 1908 the appearance of the plant was noted in a number of private gardens in different parts of St. Louis. Inquiry revealed the fact that though in some instances the plant had been observed during 1907 it had not been observed previously. Hence it is probable that the plant was introduced in St.

DIAGRAM 6.



FLOWERING OF FAMILIES, BY MONTHS.

Louis some years ago but up to 1907 did not find conditions favorable to the production of a large quantity of seed. However, since *Commelina communis* produces large quantities of seed with the utmost ease, the alternative view might be taken that the conditions for germination were exceptionally favorable during the spring of 1908 and that to this must be ascribed its frequency during the present year. The same explanation would apply to the frequency of any one weed during a certain year.

The distribution and phenological tables give the names of a number of plants occurring in the section under discussion. The nomenclature of Gray's Manual 6 ed. has been followed. The list is not complete but merely aims to give the principal plants. It includes some 850 species, being 50% of the phanerogams and vascular cryptogams occurring within a radius of twenty miles from St. Louis. The present list is based primarily on the writer's collections extending over a period of three years as well as on the extensive collections of local plants preserved in the herbarium of the Missouri Botanical Garden, notably the collections of the late Dr. Engelmann and the late Henry Eggert. An attempt has been made to give the distribution of the different species over the various physiographic regions met with in an ideal cross section of the Mississippi south of St. Louis. Under each of these regions the various modifications have been indicated by different numbers, the number being repeated where the modification is analogous. Under a separate main caption weeds have been listed, their distribution being identical on both sides of the river. Thus 1 indicates cultivated fields, 2 the vicinity of dwellings, 3 pastures, 4 roadsides, 5 roadside and railroad ditches, 6 creek banks, 7 hillsides, 8 hilltops, 9 limestone glades, 10 sinkholes, 11 ponds or lakes, those lakes of the American Bottom which occur near the bluff being indicated by 11, 12 prairies, the same number being used to indicate the bottom lands, 12 denoting the dry bottoms, 13 thickets, 14 woods, 15 cliffs, 16 talus, 17 ravines, 18 railroad embankments, and the strip adjacent the tracks, 19 railroad cuts, 20 mud covered shores, 21 river islands, 22 mudflats, 23 sandy shores and 24 ballasted railroad tracks. By

means of different symbols it has been attempted to show when the plant is prominent. This depends not only on the stature of the plant itself and upon the color of its flowers but also on the ecological relations, especially the degree of development of others associated with it. The seasons are indicated as follows: | spring, + spring and summer, − summer, ± spring, summer, autumn, × summer and autumn, = autumn, * spring, summer, autumn, winter. Where the symbol ‡ accompanies any of the above it indicates that the plant forms a striking feature of the winter aspect. The symbol † accompanying any of the above indicates that the plant has two flowering periods. The latter will be found on the pages bearing even numbers and are indicated by the abbreviated names of the months. Thus Fl, Je, Jl indicates that the plant flowers in June and July. Where the names of the months are separated by the symbol & it means there are two distinct flowering periods as is further evident from the presence of the symbol † in other columns. The same applies to the fruiting periods indicated on the odd numbered pages. As fruiting period is recognized the time when the fruit is ripe or almost so and sufficiently advanced to form a representative herbarium specimen. In cases where the fruit stays on throughout the winter this is indicated by giving the last month of fruiting as December. For convenience in correlating the data on opposite pages the species have been numbered consecutively, the numbers being repeated on each page.

As shown by the tables and accompanying diagrams 1 to 6, even in May a considerable proportion of the local species is in flower. During the next three months this average is maintained with but slight fluctuation. In view of the fact that there is a marked increase in the number of Compositae in flower during August and September it is evident there must be a decrease in other families. This is clearly shown by the diagrams. While the Ranunculaceae and Rosaceae decrease in numbers, the Compositae increase. It is also noted that the Cyperaceae attain their maximum in June while the Gramineae do so only in August. July and August show the greatest number of species in flower.

Distribution and Phenology		Weeds					MIS- Upland								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Actaea alba	1							+		Fl	My	Je			
Anemone caroliniana	2							+		Fl	My	Je			
Anemone pennsylvanica	3									Fl	Je	Jl			
Anemone virginiana	4						×			Fl	Je	Jl			×
Anemonella thalictroides	5	+							+	Fl	Mr	My	+		+
Aquilegia canadensis	6									Fl	My	Je			
Cimicifuga racemosa	7									Fl	Je	Jl		+	+
Clematis crispa	8									Fl	My	Je			
Clematis Pitcheri	9									Fl	My	Je			
Clematis virginiana	10									Fl	Je	Jl			
Delphinium Ajacis	11									Fl	Je	Jl		+	
Delphinium tricorne	12						+	+		+	Fl	Ap	My	+	+
Hepatica acutiloba	13									Fl	Mr	Ap			
Hydrastis canadensis	14							+		Fl	+	Ap	My	+	+
Isopyrum biternatum	15									Fl	Ap	My			
Myosurus minimus	16	|		|	|				Fl	Ap	My	|		
Ranunculus abortivus	17	±	±	±	±	±	±		Fl	Ap	S	±			
Ranunculus abortivus Harveyi	18						±			Fl	Ap	S			
Ranunculus fascicularis	19				|			|	|	Fl	Ap	My			|
Ranunculus multifidus	20									Fl	Ap	S			
Ranunculus oblongifolius	21									Fl	My				
Ranunculus recurvatus	22									Fl	Ap	My			
Ranunculus repens	23						±			Fl	Ap	Ag			
Ranunculus septentrionalis	24						±	±		Fl	Ap	Jl			
Thalictrum purpurascens	25									Fl	Je			+	+
Asimina triloba	26						*			Fl	Ap	My			
Menispermum canadense	27						±	±		Fl	My	Je		±	±
Podophyllum peltatum	28						+	+		Fl	My	Je		+	+
Nelumbo lutea	29									Fl	Jl	Ag			
Nuphar advena	30									Fl	My	Ag			
Nuphar advena minus	31									Fl	My	Ag			
Nymphaea odorata	32									Fl	My	S			
Sanguinaria canadensis	33						|	|	|	Fl	Mr	Ap		|	|
Stylophorum diphyllum	34									Fl	My				
Corydalis aurea	35						|	|		Fl	Ap	My			|
Dicentra Cucullaria	36									Fl	Mr	Ap			
Arabis canadensis	37									Fl	Je	Jl			
Arabis confinis	38									Fl	Ap	Je			
Arabis dentata	39									Fl	Ap	My			
Arabis hirsuta	40	|								Fl	Ap	My			
Arabis laevigata	41							+		Fl	Ap	My			
Arabis ludoviciana	42									+	Fl	Ap	My		
Arabis lyrata	43									Fl	Ap	My			
Brassica alba	44		×							Fl	Je	Jl			
Brassica campestris	45				+					Fl	My	Je			
Brassica nigra	46	—			—					Fl	Je	Jl			
Brassica Sinapistrum	47	+								Fl	My	Jl			
Camelina sativa	48	+								Fl	My	Je			
Capsella Bursa-pastoris	49	*	*	*	*	*	*	*	*	Fl	Mr	N	*	*	*
Cardamine hirsuta	50	|				|				Fl	Ap	My			
Cardamine rhomboidea	51									Fl	My	Ag			
Dentaria laciniata	52									Fl	Ap	My			

SOURI												ILLINOIS																			
Bluff			Lowland						River				Lowland									Bluff		Upland							
15	16	17	5	18	19	11	12	12	20	21	22	23	26	25	14	11	12	12	11	18	24	16	15	14	12	7	6				
		+										1				Fr	Jl	Ag						+							
												2				Fr	Ag	S					+								
							×					3				Fr	Jl	×	×		×			×							
	×	×										4				Fr	Ag	S				×	×	×	×		×				
	+	+										5				Fr	Je	Jl				+	+	+	+		+				
+		+										6				Fr	Jl	Ag					+								
												7				Fr	Jl	Ag						+							
				±								8				Fr	Ag	S													
	±											9				Fr	Ag	S				±									
	±						±					10			Fr	S	O	±				±						±			
	+	+										11				Fr	Jl														
	+	+										12				Fr	My	Je				+				+					
												13				Fr	My	Je													
												14				Fr	Jl		+			+		+							
												15			Fr	Je	+											+			
												16			Fr	My	|	|		|											
	±	±		Fr	My	O	±	±				17		±	±	±	±	±	±		±	±		±				±			
		±										18				Fr	My	Je													
												19				Fr	My	Je						|	|	|				
												20				Fr	My	O	×												
												21					+	Fr	Jl												
		|									22				Fr	My	Je						|							
		±		Fr	My	S		±				23				±		±	±			±									
	±	±		Fr	My	Ag		±				24				±	±	±	±			±						±			
												25				Fr	Jl	Ag		+				+				+			
	*	*						*				26				Fr	S	O				*						*			
	±											27			Fr	S	D	±				±		±				±			
	+	+										28				Fr	Ag	S				+		+				+			
												29				×	Fr	Ag	O												
												30				×	Fr	Jl	S												
												31				Fr	Jl	S	×												
												32				×	Fr	Je	O												
	|	|									33				Fr	My	Je				|		|				|		
												34				Fr	Jl					—									
				|	|						35				Fr	My	Je		|				|						
	|										36				Fr	My	Je				|		|				|		
×		×										37			Fr	Jl	S	×					×								
												38				Fr	My	Jl				+									
		+										39				Fr	My	Je	+			+		+				+			
	|										40				Fr	My	Je				|		|							
												41				Fr	My	Jl					+	+							
+												42				Fr	My	Ag					+								
												43				Fr	My	Je					|								
												44				Fr	Jl	Ag													
												45				Fr	Je	Jl													
				—								46				Fr	Jl	Ag		—											
												47				Fr	Je	Ag													
												48				Fr	Je	Jl													
*	*	*	*	*	*		*	*	*	*	*	49		Fr	*	Ap	*	*	D	*	*	*	*	*	*	*	*	*				
												50				Fr	My	Je													
												51	+			+	Fr	Jl	Ag												
	|	|									52			Fr	My	Je	|					|		|						

Distribution and Phenology		Weeds					MIS- Upland								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Draba brachycarpa	1									Fl	Ap				|
Draba caroliniana	2	|								Fl	Mr	Ap			
Draba cuneifolia	3									|	Fl	Mr	My		
Erysimum asperum	4									Fl	Ap	My			
Lepidium intermedium	5									Fl	My	O			
Lepidium virginicum	6	±	±		±					Fl	My	O	±		
Nasturtium Armoracia	7		*							Fl	My				
Nasturtium lacustre	8									Fl	My				
Nasturtium obtusum	9									Fl	My	Je			
Nasturtium officinale	10									Fl	Ap	N			
Nasturtium palustre	11									Fl	My	Jl			
Nasturtium sessiliflorum	12									Fl	My				
Nasturtium sinuatum	13									Fl	My	Jl			
Raphanus sativus	14		×							Fl	Je	S			
Sisymbrium altissimum	15									Fl	Ap	My			
Sisymbrium canescens	16									Fl	Ap	Je	|		
Sisymbrium officinale	17	±			±					Fl	My	Ag	±		
Polanisia graveolens	18									Fl	Je	Jl			
Helianthemum canadense	19									Fl	My	Je	+		
Lechea major	20									Fl	Je	Jl	*‡		
Lechea minor	21								*‡		Fl	Jl			
Solea concolor	22							|†		Fl	Ap	&	S		
Viola palmata	23						±†	±†	Fl	Ap	My	&	Jl	±†	±†
Viola palmata cucullata	24						±†	±†	Fl	Ap	My	&	Jl	±†	±†
Viola pedata	25								|†	Fl	Ap	My	&	S	
Viola pedata bicolor	26								|†	Fl	Ap	My	&	S	
Viola pedatifida	27									Fl	Ap	My			
Viola pubescens	28									Fl	Ap	My			
Viola Rafinesquii	29	|								Fl	Mr	Ap	|		
Viola striata	30									Fl	Ap	My			
Arenaria patula	31									|	Fl	My			
Cerastium arvense	32	+		+		+				Fl	My	Je			
Cerastium arvense oblongifolium	33	+								Fl	My	Je			
Cerastium nutans	34	±								Fl	Ap	S			±
Cerastium viscosum	35	±								Fl	Ap	S	±		±
Cerastium vulgatum	36	|								Fl	Ap	My			
Lychnis Githago	37	+								Fl	My	Je			
Saponaria officinalis	38	±	±		±					Fl	Je	S			
Silene antirrhina	39	+			+					+	Fl	My	Je		
Silene stellata	40									Fl	My	Ag			
Stellaria longifolia	41									Fl	My	Je			
Stellaria media	42	*	*		*					Fl	Mr	N			
Claytonia virginica	43	|					|	|		Fl	Mr	Ap		|	|
Portulaca oleracea	44	×	×							Fl	Jl	S			
Talinum teretifolium	45									Fl	My				
Bergia texana	46														
Ascyrum Crux-Andreae	47									×	Fl	Je	S		
Hypericum Ascyron	48									Fl	Je	Ag			
Hypericum cistifolium	49								×	Fl	Je	Ag			
Hypericum Drummondii	50									Fl	×	Je	Ag		
Hypericum maculatum	51									Fl	Jl	Ag	×		
Hypericum mutilum	52									Fl	Jl	S			

SOURI												ILLINOIS															
Bluff			Lowland						River				Lowland									Bluff		Upland			
15	16	17	5	18	19	11	12	12	20	21	22	23	26	25	14	11	12	12	11	18	24	16	15	14	12	7	6
												1				Fr	My	|			|						
												2			Fr	Ap	My	|						|		
|												3				Fr	My						|				
+												4				Fr	Je	Jl									
												5				Fr	My	O		±	±						
		±										6				Fr	My	O							±		
												7															
												8				Fr	Je		|							
									+	+	+	9	+			Fr	Je			+							
												10	±			Fr	My	N									
										+	+	11	+	+	+	+	+	Fr	+	Je	Jl						
												12		|		Fr	Je										
												13			Fr	Je	Ag	+			+						
												14				Fr	Jl	O									
												15				Fr	My	Je		|							
		|		|							16			Fr	My	Je	|		|	|						
				±	±							17			Fr	Jl	S	±		±	±				±		
—				—	—							18				Fr	Jl	Ag		—	—						
												19				Fr	Jl	Ag							+	+	
*‡												20				Fr	Jl	S							*‡		
*‡												21				Fr	Ag	S							*‡	*‡	
		|†										22				Fr	Je	&	O								
N	±†	±†		±†	±†		±†					23			±†	Fr	Je	±†	N	±†	±†	±†		±†		±†	±†
N	±†	±†		±†	±†		±†					24			±†	Fr	Je	±†	N	±†	±†	±†		±†		±†	±†
												25			Fr	My	Je	&	O							
												26			Fr	My	Je	&	O							
												27				Fr	My	Je								
								|				28				Fr	|	Ag				|		|		
		|		|	|							29				Fr	Ap	My		|					|	
												30				Fr	|	Je	Jl			|					
												31				Fr	Je										
					+							32				Fr	Je	+	Jl		+						
												33				Fr	Je	+	Jl								
								±				34		Fr	Je	O	±	±						±			
				±	±							35		Fr	Je	O	±	±		±	±						
												36				Fr	My	Je									
				+								37				Fr	Jl			+							
												38				Fr	Ag	O									
+												39				Fr	Jl	Ag					+		+		
	±											40				Fr	Ag	S				±		±			
												41		Fr	Jl	|	|		|								
				*	*							42				Fr	My	D		*	*						
		|										43			|		Fr	Je						|		|	|
				×								44				Fr	Ag	O		×							
												45				Fr	Je						|				
												46								—							
												47				Fr	Ag	O									
												48				Fr	S					×			×		
												49				Fr	S	×									
												50				Fr	S -							×			
×	×		×		×							51				Fr	S	×		×	×			×		×	
	×		×						×			52				Fr	×	S	O			×					

Distribution and Phenology		Weeds					MIS- Upland								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Hypericum nudicaule	1									×	Fl	Jl	S		
Hypericum perforatum	2	×			×	×				Fl	Je	O			
Hypericum prolificum	3									Fl	Jl	S			
Abutilon Avicennae	4	×	×		×					Fl	Je	S	×		
Hibiscus lasiocarpus	5									Fl	Ag				
Hibiscus militaris	6									Fl	Ag				
Hibiscus Trionum	7									Fl	Ag				
Malva rotundifolia	8	×	×		×					Fl	My	N			
Sida spinosa	9	×		×						Fl	Je	Ag			
Tilia americana	10									Fl	My	Je			
Linum sulcatum	11									Fl	My	Je			
Linum usitatissimum	12		×		×					Fl	Je	S			
Linum virginianum	13									Fl	Jl	Ag			
Tribulus grandiflorus	14									Fl	Jl	Ag			
Geranium carolinianum	15	±	±		±	±		±		Fl	My	Je	±	±	±
Geranium maculatum	16						+	+		Fl	Ap	Je	+	+	+
Impatiens fulva	17						×			Fl	Jl	S			
Impatiens pallida	18						×			Fl	Jl	S			
Oxalis cymosa	19							±		Fl	Je	O		±	±
Oxalis stricta	20	±	±	±	±	±	±	±	±	Fl	Mr	N	±	±	±
Oxalis violacea	21						Fl	+†	+†	Ap	+†	My	&	S	+†
Ptelea trifoliata	22						*	*		Fl	My				
Ailanthus glandulosus	23		*							Fl	My				
Ilex decidua	24									Fl	My				
Celastrus scandens	25							*		Fl	My			*	
Euonymus atropurpureus	26							*		Fl	*	My	Je	*	
Ceanothus americanus	27							*		Fl	Je	Jl			*
Rhamnus caroliniana	28								*	Fl	Je				
Rhamnus lanceolata	29						*	*	Fl	*	Ap	My	*	*	
Ampelopsis quinquefolia	30						*	*		Fl	Jl				*
Cissus Ampelopsis	31						*			Fl	My				
Cissus stans	32									Fl	My				
Vitis aestivalis	33								*	Fl	My				
Vitis cinerea	34						*			Fl	My				
Vitis cordifolia	35						*		Fl	My	*	*			
Vitis palmata	36									Fl	My				
Vitis riparia	37						*	*		Fl	My	*		*	
Vitis riparia praecox	38									Fl	My				
Acer dasycarpum	39									Fl	Mr	Ap			
Acer rubrum	40									Fl	Mr	Ap			
Acer saccharinum	41						*	*		Fl	*	Ap	My		*
Aesculus glabra	42									Fl	Ap				
Cardiospermum Halicacabum	43									Fl	Jl	Ag			
Negundo aceroides	44									Fl	Ap				
Staphylea trifolia	45						*			Fl	Ap	*	My		
Rhus canadensis	46							*	*	Fl	Mr	Ap		*	*
Rhus copallina	47								*	Fl	Jl		*		*
Rhus glabra	48				*			*	*	Fl	My	Je	*	*	*
Rhus Toxicodendron	49				*		*	*		Fl	My	*		*	*
Polygala verticillata	50									+	Fl	My	+		
Amorpha canescens	51								±	Fl	Je	Jl			
Amorpha fruticosa	52						±			Fl	Ap	My			

| SOURI | | | | | | | | | | | | ILLINOIS | | | | | | | | | | | |

Distribution and Phenology		Weeds					MIS-								
							Upland								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Amphicarpaea monoica	1							×	×	Fl	Jl	Ag		×	×
Amphicarpaea Pitcheri	2							×	×	Fl	Jl	Ag		×	×
Apios tuberosa	3						×			Fl	Ag				
Astragalus canadensis	4									Fl	Jl				
Astragalus mexicanus	5								Fl	±	Mr	Ap	±		
Baptisia leucantha	6									Fl	Jl	Ag			
Baptisia leucophaea	7							+	+	Fl	Ap	My			
Cassia Chamaecrista	8	×			×					Fl	Jl	S	×	×	
Cassia marilandica	9									Fl	Ag	×	S		×
Cassia nictitans	10									Fl	Jl	S			
Cercis canadensis	11							*		Fl	Mr	Ap		*	*
Crotalaria sagittalis	12									—	Fl	Je	Jl		
Dalea alopecuroides	13									Fl	Ag	S			
Desmanthus brachylobus	14									Fl	Jl	Ag			
Desmodium acuminatum	15							×		Fl	Jl	Ag			
Desmodium canadense	16	×			×					Fl	Je	Jl			
Desmodium canescens	17	×			×					Fl	Ag		×		
Desmodium ciliare	18									Fl	Jl	Ag			
Desmodium cuspidatum	19						×	×		Fl	Ag	S		×	×
Desmodium Dillenii	20								×	Fl	×	Ag	×	S	
Desmodium marylandicum	21							×		Fl	Jl	Ag			×
Desmodium nudiflorum	22							×		Fl	Jl	Ag			
Desmodium paniculatum	23									Fl	Jl	Ag			
Desmodium rigidum	24									Fl	Jl	Ag			
Desmodium rotundifolium	25								×	Fl	Jl	Ag			×
Desmodium sessilifolium	26									Fl	Jl	Ag			
Gleditschia aquatica	27									Fl	My	Je			
Gleditschia triacanthos	28						*	*		Fl	Ap	My			
Glycyrrhiza lepidota	29									Fl	Jl				
Gymnocladus canadensis	30									Fl	Ap	My			
Lathyrus palustris myrtifolius	31									Fl	My	Je			
Lespedeza capitata	32	×								×	Fl	Jl	×	Ag	
Lespedeza procumbens	33				×			×	×	Fl	Je	Ag	×		
Lespedeza reticulata	34							×	×	Fl	Jl	Ag			×
Lespedeza violacea	35								×	Fl	Ag	S			×
Medicago lupulina	36	×								Fl	Je	S			
Medicago sativa	37	±	±		±					Fl	My	S			
Melilotus alba	38	±	±		±					Fl	Je	Ag	±		
Melilotus officinalis	39	+	+		+					Fl	My	Je			
Petalostemon candidus	40									×	Fl	Je	Ag		
Petalostemon villosus	41									Fl	Je	Ag			
Petalostemon violaceus	42									×	Fl	Je	Ag		
Psoralea Onobrychis	43									Fl	Je	Ag		×	
Psoralea tenuiflora	44								×	Fl	Je	Ag	×		
Robinia Pseudacacia	45	*	*		*				*	Fl	My				
Strophostyles angulosa	46							×		Fl	Jl	N	×	×	
Strophostyles pauciflora	47	×								Fl	Ag	N			
Stylosanthes elatior	48									Fl	Ap	My			
Tephrosia virginica	49								×	Fl	Je	Jl			
Trifolium hybridum	50	—	—		—					Fl	My	Ag			
Trifolium pratense	51	±	±	±	±					Fl	My	O			
Trifolium procumbens	52							—		Fl	My	Jl			—

| SOURI | | | | | | | | | | ILLINOIS | | | | | | | | | |

Distribution and Phenology		Weeds					MIS-								
							Upland								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Trifolium reflexum	1									Fl	My	Jl			
Trifolium repens	2	±	'±	±	±					Fl	Ap	N	±		±
Trifolium stoloniferum	3									Fl	Je	Ag			
Agrimonia Eupatoria	4							±	Fl	My	Jl	±		±	±
Agrimonia parviflora	5							±	Fl	Je	Jl	±		±	±
Amelanchier canadensis	6									Fl	Ap	My			
Crataegus acutifolia	7									Fl	My				
Crataegus atrorubens	8									Fl	My				
Crataegus declivitatis	9									Fl	Ap				
Crataegus Engelmanni	10									Fl	*	My			
Crataegus erecta	11									Fl	My				
Crataegus fecunda	12									Fl	My				
Crataegus insignis	13									Fl	My				
Crataegus Kelloggii	14									Fl	Ap				
Crataegus lanceolata	15									Fl	My				
Crataegus lanigera	16									Fl	Ap				
Crataegus larga	17									Fl	My				
Crataegus ludoviciensis	18									Fl	My				
Crataegus macrophylla	19									Fl	Ap				
Crataegus mitis	20									Fl	My				
Crataegus nitida	21									Fl	My				
Crataegus ovata	22									Fl	My				
Crataegus patrum	23									Fl	My				
Crataegus rubicundula	24									Fl	My				
Crataegus umbrosa	25									Fl	Ap				
Crataegus viridis	26									Fl	My				
Fragaria virginiana	27							±		Fl	Ap	My			±
Geum album	28							±		Fl	My	Jl		±	±
Geum vernum	29									Fl	Ap	My			
Gillenia stipulacea	30								±	Fl	My	Jl			
Physocarpus opulifolius	31						*			Fl	My				
Potentilla canadensis	32	±	±	±	±			±	±	Fl	Ap	Ag	±	±	±
Potentilla norvegica	33			×						Fl	Je	Jl			
Potentilla rivalis millegrana	34									Fl	Je	Jl			
Potentilla supina	35									Fl	Je	Jl			
Prunus americana	36						*	*		Fl	Ap			*	
Prunus Persica	37		*							Fl	Ap		*	*	
Prunus serotina	38						*	*	*	Fl	My			*	*
Prunus virginiana	39									Fl	Ap				
Pyrus coronaria	40							*			*	Fl	My	*	*
Rosa arkansana	41										Fl	My		*	
Rosa blanda	42							*	*	*	Fl	My	Je	*	
Rosa humilis	43							*	*	*	Fl	My	S	*	
Rosa setigera	44						*			Fl	Je	S			
Rubus canadensis	45				*					Fl	Ap	My		*	
Rubus occidentalis	46									Fl	My	Je		*	
Rubus villosus	47					*		*		Fl	My	Je		*	
Spiraea Aruncus	48										±	Fl	My		±
Heuchera americana	49							±		Fl	Ap	My			±
Heuchera hispida	50									Fl	My	Je			
Hydrangea arborescens	51						*			Fl	My	Je			
Ribes gracile	52										*	Fl	My	*	*

SOURI									ILLINOIS																					
Bluff			Lowland						River				Lowland										Bluff		Upland					
15	16	17	5	18	19	11	12	12	20	21	22	23	26	25	14	11	12	12	11	18	24	16	15	14	12	7	6		
												1				Fr	Je	Ag				×							
	±			±	±		±					2			Fr	My	N	±		±					±					
		×										3		×		×	Fr	Jl	S											
	±											4				Fr	Je	S				±		±						
	±											5				Fr	Ag	S				±		±						
*							*					6				Fr	Je	Jl					*				*			
												7				*	*	Fr	S											
												8					*	Fr	O											
*												9				Fr	O													
												10				Fr	N													
							*	*				11			Fr	S	*	*												
												12			Fr	O	*													
												13			Fr	N	*													
								*				14				Fr	S													
								*				15				Fr	O	N												
												16				Fr	*	Ag												
												17				Fr	*	O												
								*				18				Fr	S	O												
								*				19				Fr	O													
												20			Fr	O	*													
												21			Fr	O	*													
								*				22				Fr	S	O												
								*				23				Fr	O													
								*				24				Fr	O	N												
								*				25				Fr	S													
								*				26				Fr	*	S	O											
				±	±							27				Fr	My	Je		±				±		±				
												28			Fr	Jl	S	±						±						
	±	±										29			Fr	±	±	Jl	±	Ag		±								
±												30				Fr	Je	S					±			±				
		*										31				Fr	Jl	Ag												
	±			±	±		±					32			Fr	My	O	±		±		±		±	±	±				
	×											33				Fr	×	Ag	S			×								
												34			Fr	×	×	Ag	×	S										
							×					35			Fr	Jl	Ag	×					×							
*												36				Fr	Jl	*					*				*			
												37				Fr	Ag	S												
	*	*					*			*		38		*		Fr	Ag	*	*			*		*		*	*			
												39				Fr	Je	Jl									*			
												40			Fr	Jl	S	*						*			*			
												41				Fr	Je	Jl						*						
												42				Fr	Je	Jl									*			
*												43				Fr	Je	O					*	*						
	*							*				44		*	Fr	*	*	Ag	*	O			*				*			
				*	*		*					45		Fr	*	*	Je	*	*	*	Jl			*						
	*						*					46			*	Fr	Je	Jl						*						
	*			*	*		*					47				Fr	Jl			*	*	*		*			*			
	±											48				Fr	S						±	±						
±	±				±							49				Fr	Je	Jl				±	±	±					±	
+												50				Fr	Jl	Ag					+							
	*	*										51				Fr	Ag					*							*	
												52				Fr	Je	Jl						*		*				

Distribution and Phenology		Weeds					MIS- Upland									
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Penthorum sedoides	1								Fl	Jl	Ag	×				
Callitriche deflexa Austini	2						±			Fl	A p	Je				
Proserpinaca palustris	3									Fl	Jl					
Ammania coccinea	4					×				Fl	Jl	S				
Cuphea viscosissima	5							×		×	Fl	My	Ag			
Decodon verticillatus	6									Fl	Jl					
Lythrum alatum	7					×				Fl	Je	S				
Rotala ramosior	8									Fl	Jl	Ag				
Circaea Lutetiana	9						+			Fl	Je	Jl				
Epilobium coloratum	10									Fl	Jl					
Gaura biennis	11									×	Fl	Jl	S			
Gaura parviflora	12									Fl	My	Jl				
Jussieua repens	13								Fl	Je	O	±				
Ludwigia palustris	14									Fl	Jl	S				
Oenothera biennis	15	*‡	*‡		*‡					Fl	My	C	*‡			
Oenothera biennis muricata	16									Fl	Je	S	*‡			
Oenothera fruticosa	17									Fl	Je	S				
Oenothera sinuata	18									Fl	Jl	Ag				
Mentzelia oligosperma	19									Fl	Je	Jl				
Passiflora lutea	20										×	Fl	Jl	×	×	
Citrullus vulgaris	21		×		×					Fl	Jl	S				
Citrullus ovifera pyriformis	22		×		×					Fl	Jl	S				
Echinocystis lobata	23						×			Fl	Jl	Ag				
Sicyos angulatus	24						×			Fl	Jl	Ag				
Opuntia Rafinesquii	25								Fl	*	Jl	S	*			
Mollugo verticillata	26	±	±		±					Fl	My	N				
Chaerophyllum procumbens	27									Fl	A p	My				
Cicuta maculata	28									Fl	A p	Je				
Coriandrum sativum	29		×							Fl	My	S				
Cryptotaenia canadensis	30									Fl	A p	Jl				
Daucus Carota	31	±								Fl	Jl				±	
Discopleura Nuttallii	32									Fl	Je	Jl				
Erigenia bulbosa	33									Fl	Mr	A p				
Eryngium yuccaefolium	34								±	Fl	±	My	S		±	
Foeniculum officinale	35		±							Fl	Je	Jl				
Osmorrhiza brevistylis	36									Fl	A p	My				
Osmorrhiza longistylis	37									Fl	A p	My				
Pimpinella integerrima	38							+	+	+	Fl	My	+			
Polytaenia Nuttallii	39									+	Fl	My				
Sanicula marylandica	40							+		Fl	+	A p	My		+	
Sanicula marylandica canadensis	41						+	+		Fl	+	A p	My		+	
Sium cicutaefolium	42									Fl	Jl	Ag				
Thaspium aureum	43							±		±	Fl	A p	My		±	
Thaspium aureum trifoliatum	44									Fl	A p	My			±	
Tiedemannia rigida	45									Fl	Jl	Ag			±	
Zizia aurea	46							±		±	Fl	A p	Je			
Aralia quinquefolia	47							+		Fl	My	Je				
Aralia racemosa	48									Fl	Je	Jl				
Cornus asperifolia	49				*					Fl	Je			*	*	
Cornus florida	50									Fl	A p	My	*		*	
Cornus paniculata	51									Fl	My					
Cornus sericea	52									Fl	My					

SOURI												ILLINOIS															
Bluff			Lowland						River				Lowland									Bluff		Upland			
15	16	17	5	18	19	11	12	12	20	21	22	23	26	25	14	11	12	12	11	18	24	16	15	14	12	7	6
												1	×			×	Fr	S									
	±											2				Fr	My	S				±					
												3				×	Fr	S	×								
												4		×		Fr	×	S	O								
												5				Fr	Jl	O								×	
												6				×	Fr	S	×	O							
		×										7		×		Fr	×	Ag	O								
											×	8	×			Fr	S										
	+	+										9				Fr	Jl	Ag				+		+			
												10				Fr	S					×					
												11				Fr	Ag	O					×				
												12				Fr	Je	S						+			
						±						13	±	±	Fr	±	Jl	N	±								
											×	14		×	Fr	×	Ag	O	×								
				*‡	*‡						15	*‡		Fr	Jl	D	*‡	*‡		*‡	*‡				*‡	*‡	
				*‡								16			Fr	Jl	O	*‡		*‡							
												17			Fr	Jl	O	×							×	×	
												18			Fr	S	O	×		×	×						
												19				Fr	Jl	Ag					+				
	×	×										20				Fr	Ag	S				×		×			
												21				Fr	Ag	S									
												22				Fr	×	S	O								
								×				23				×	×	Fr	Ag	S							×
								×				24				×	×	Fr	S	O							×
												25				Fr	Jl	*	D						*		
				±								26				Fr	My	N		±	±						
	|	|					|	|			27			|	Fr	|	|	My	Je		|				
									±			28			Fr	±	±	Jl	Ag								
												29				Fr	Je	O									
					±							30			Fr	Ag	±	±	±	O					±		
				±						±		31				Fr	Ag	S		±							
	±								±			32		±		Fr	Ag	S									
	|											33				Fr	My	Je				|					
±				±								34				Fr	Jl	N					±				
	+											35				Fr	Jl	S									
												36				Fr	My	Je				+		+			
												37				Fr	Je	Jl				+		+			
+	+				+							38				Fr	Jl					+	+	+	+		
												39				Fr	Jl	Ag					+		+		
	+	+										40				Fr	Jl	Ag				+		+		+	
	+	+										41				Fr	Jl	Ag				+		+		+	+
												42	±	±	Fr	±	±	S	±	O							
												43				Fr	Ag	S					±				
	±											44				Fr	Ag	S				±		±			±
												45				Fr	Ag	S									
		+										46				Fr	Jl	S									
												47				Fr	Jl	Ag				+					+
±		±										48				Fr	Ag	S					±				
		*										49			Fr	*	Jl	*	*	Ag				*			*
		*										50				Fr	S							*			
												51				Fr	Jl	Ag									*
												52			Fr	*	Jl	Ag	*								

Distribution and Phenology		Weeds					MIS- Upland								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Sambucus canadensis	1						*	*		Fl	*	Je	Jl	*	*
Symphoricarpus vulgaris	2				*‡			*‡	*‡	Fl	Jl	Ag	*‡	*‡	
Triosteum angustifolium	3								±	Fl	My		±		±
Triosteum perfoliatum	4								±	Fl	My	Je	±	±	±
Viburnum Lentago	5						*			Fl	Ap	My			
Viburnum prunifolium	6							*	*	Fl	Ap	My	*		*
Viburnum rufotomentosum	7									Fl	My				
Cephalanthus occidentalis	8								Fl	Je	Jl	*‡			
Diodia teres	9									Fl	Je	Jl	×		
Galium Aparine	10									Fl	Ap	My		+	
Galium asprellum	11									Fl	My	Je			
Galium circaezans	12							±		Fl	Je	Jl			
Galium concinnum	13									Fl	Je	Jl		±	
Galium pilosum	14							×		Fl	Jl	S			
Galium triflorum	15									Fl	Je	Jl			
Houstonia angustifolia	16								Fl	±	Ap	Ag			
Houstonia minima	17			|						Fl	Mr	My	|		|
Houstonia purpurea	18									±	Fl	Ap	S		±
Houstonia purpurea longifolia	19										Fl	Ap	S		±
Spermacoce glabra	20					±			Fl	My	S	±			
Valerianella radiata	21									Fl	Ap	My			
Dipsacus sylvestris	22				*					Fl	Je	Jl			
Achillea Millefolium	23	*	*	*	*					Fl	My	S	*		*
Actinomeris squarrosa	24						×	×		Fl	Jl	S	×		×
Ambrosia artemisiaefolia	25	×		×		×				Fl	Ag				
Ambrosia bidentata	26									Fl	S				
Ambrosia psilostachya	27									Fl	Jl	Ag			
Ambrosia trifida	28	×	×							Fl	Ag	S			
Antennaria plantaginifolia	29				±				±	Fl	Mr	My	±		±
Anthemis Cotula	30	×	×		×					Fl	Je	Ag			
Arctium Lappa minus	31	*	*	*	*					Fl	Jl	S			
Artemisia biennis	32									Fl	Ag	S			
Artemisia Ludoviciana	33									Fl	S	O			
Aster azureus	34							=		Fl	S				=
Aster cordifolius	35							=		Fl	S				=
Aster diffusus	36									Fl	S				
Aster Drummondii	37									Fl	S				
Aster ericoides	38	=			=					Fl	S				
Aster laevis	39									=	Fl	S			
Aster linariifolius	40								=	Fl	S				
Aster multiflorus	41	=			=					Fl	S				
Aster novae-angliae	42						=			Fl	S		=		
Aster oblongifolius	43									=	Fl	S			
Aster oblongifolius rigidulus	44									Fl	S				
Aster patens	45							=	=	Fl	S		=		
Aster sagittifolius	46									Fl	S		=		
Aster salicifolius	47									Fl	S	=			
Aster turbinellus	48							=	=	Fl	S				=
Bidens Beckii	49									Fl	Ag				
Bidens bipinnata	50									Fl	Ag	S			
Bidens cernua	51									Fl	Ag	S			

SOURI												ILLINOIS																
Bluff			Lowland						River				Lowland									Bluff		Upland				
15	16	17	5	18	19	11	12	12	20	21	22	23	26	25	14	11	12	12	11	18	24	16	15	14	12	7	6
	*	*		*	*					*		1			Fr	Ag	S	*	*	*		*		*			*
*‡		*‡										2			Fr	S	D	*‡						*‡	*‡	*‡	*‡
												3				Fr	Jl	Ag	±					±	±		
												4				Fr	S	O	±					±	±	±	
												5				Fr	S	O									*
*		*										6				Fr	S	N						*			
*		*					*‡					7				Fr	S	N					*				
				×								8	*‡	*‡	Fr	*‡	S	D	*‡								
	+	+										9				Fr	S	O									
		±										10				Fr	Je	Jl					+	+			
		±										11				Fr	Jl	Ag						+			
		×										12				Fr	Ag	S						±			
							±					13				Fr	Ag	S						±			
±												14				Fr	Ag	O									
												15			Fr	Ag	S	±									
												16				Fr	Je	S					±		±		
±												17				Fr	Ap	|	My						|		
												18				Fr	Je	±	S					±			
±												19				Fr	Je	S									
						±		±				20				±	±	Fr	±	Je	O						
								|				21			Fr	My	Je	|	|			|				
												22				Fr	Ag	S									
					*							23			Fr	Jl	N	*						*	*	*	
×							×					24			Fr	S	O	×					×		×		×
				×								25	Fr	S	O	×	×	×	×	×	×				×		
												26			Fr	S	O	×							×		
												27				Fr	S			×					×		
				×				×		×	×	28		Fr	O	×	×	×		×					×		
					±							29				Fr	Ap	My			±		±		±	±	
												30				Fr	Jl	O			×					×	
				*								31			Fr	Ag	N	*		*					*	*	
							×					32				Fr	S	O									
									=		33	=				Fr	O	N									
		=										34				Fr	O							=			
=		=										35				Fr	O						=	=			
								=				36				=	=	Fr	O								
	=											37				Fr	O								=		
					=							38				Fr	O			=					=	=	
												39				Fr	O						=		=		
												40				Fr	O								=		
				=	=							41				Fr	O						=		=		
=												42				Fr	O						=		=		=
=												43				Fr	O						=				
												44				Fr	O						=				
												45				Fr	O	=		=					=	=	
												46				Fr	O						=				
						=		=				47		=		=	Fr	O									
		=										48				Fr	O							=	=		
												49		×		×	Fr	S	O								
×				×			×					50				Fr	S	×	O					×			×
								×			×	51				Fr	S	O	×								

Distribution and Phenology		Weeds					MIS-								
							Upland								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Bidens chrysanthemoides	1									Fl	Ag	S			
Bidens connata	2									Fl	S				
Bidens frondosa	3									Fl	S				
Boltonia asteroides	4									Fl	Ag	S			
Boltonia asteroides decurrens	5									Fl	Ag	S			
Cacalia atriplicifolia	6							±		Fl	Jl	Ag			±
Cacalia reniformis	7							±		Fl	Jl	Ag			
Cacalia tuberosa	8									±	Fl	My	Jl		
Chrysanthemum Leucanthemum	9		±		±					Fl	My	Jl			
Chrysopsis villosa	10				±				±	Fl	Jl				
Cichorium Intybus	11		×			×				Fl	Jl	Ag			
Cnicus altissimus	12			±	±			±		Fl	Jl	Ag		±	±
Cnicus arvensis	13	±		±						Fl	Jl	Ag	±		
Cnicus pumilus	14	±		±						Fl	Jl	S	±		
Coreopsis aristosa	15	×	×						Fl	Ag	O	×			
Coreopsis aristosa mutica	16	×	×		×				Fl	Ag	O	×			
Coreopsis palmata	17									Fl	Je	Jl			
Coreopsis tinctoria	18		×							Fl	Je	Jl			
Coreopsis tripteris	19						×			Fl	Jl	Ag			
Dysodia chrysanthemoides	20									Fl	Ag	S			
Echinacea angustifolia	21									×	Fl	Jl	Ag		
Echinacea purpurea	22									Fl	Jl	Ag		×	×
Eclipta alba	23					±			Fl	Jl	S	±			
Elephantopus carolinianus	24							×	×	Fl	Jl	S			×
Erechtites hieracifolia	25							×		Fl	Ag	S			×
Erigeron annuus	26	|	|	|	|			|		Fl	Ap	My		|	|
Erigeron bellidifolius	27								*	Fl	Ap	My			*
Erigeron canadensis	28	±		±	±				±	Fl	Jl	S	±		±
Erigeron philadelphicus	29	±	±		±					Fl	My	S	±		
Erigeron strigosus	30	±		±	±					Fl	Je	S			
Eupatorium ageratoides	31							×		Fl	Ag	S		×	×
Eupatorium altissimum	32							×		×	Fl	Ag	S		
Eupatorium coelestinum	33							×		Fl	Ag	S			
Eupatorium perfoliatum	34									Fl	Ag	S			
Eupatorium purpureum	35						×			Fl	Jl	Ag			
Eupatorium serotinum	36	×	×	×	×			×	Fl	Ag	×	S	×		
Gnaphalium polycephalum	37	±		±					±	Fl	Ap	My			
Helenium autumnale	38									Fl	Ag	S			
Helenium nudiflorum	39						×		Fl	Ag	S	×			
Helianthus annuus	40	×	×		×					Fl	Jl	S			
Helianthus doronicoides	41									Fl	Jl	S			
Helianthus grosse-serratus	42									Fl	Ag	S	×		
Helianthus hirsutus	43									Fl	Jl	Ag			
Helianthus laetiflorus	44								×	×	Fl	Ag	×		
Helianthus mollis	45									Fl	Jl	O	×		
Helianthus occidentalis	46								×	Fl	Ag			×	×
Helianthus rigidus	47									Fl	Ag				
Helianthus tuberosus	48	×	×		×					Fl	Ag	S			
Heliopsis laevis	49									Fl	Jl	S	×		×
Heliopsis scabra	50									Fl	Ag	S	×		
Iva ciliata	51								Fl	Ag	S	×			
Krigia amplexicaulis	52							+		Fl	Ap	Je	+		+

SOURI									ILLINOIS																
Bluff			Lowland						River				Lowland										Bluff		Upland			
15	16	17	5	18	19	11	12	12	20	21	22	23	26	25	14	11	12	12	11	18	24	16	15	14	12	7	6
											×	1				×	Fr	O	×	N							×
										2	×	×		×		×	Fr	O	×			×		×			
												3				×	Fr	O									
												4				×	×	Fr	×	S	O	×					
												5					×	Fr	S	O							
	±	±										6				Fr	S	O				±		±			
	±	±										7				Fr	S	O				±		±			
												8				Fr	S	O									
				±	±							9				Fr	Jl	Ag		±	±						
					±							10				Fr	Ag	±	S						±		
												11				Fr	S			×	×						
				±	±							12				Fr	Ag	S	±					±			
												13				Fr	Ag	S									
												14				Fr	Ag	N							±		
						×		×				15		×		×	×	Fr	×	S	N						
						×		×	×			16		×		×	×	Fr	×	S	N						
×												17				Fr	Ag	S					×		×		
												18				Fr	Ag	S		×							
				×	×							19				Fr	S			×	×			×			
												20				Fr	S	×	O						×		
												21				Fr	Ag	S						×		×	
												22				Fr	Ag	S						×			
			±			±						23			±	±	±	Fr	±	S	O						±
		×										24				Fr	S	×	O					×	×		
		×										25				Fr	S	O						×			
												26				Fr			My	Je							
												27				Fr	My	Je						*	*		
				±	±		±					28				Fr	±	±	S	±	O			±	±	±	
	±	±		±								29				Fr	Je	±	N	±				±	±		
				±	±		±					30				Fr	Ag	±	N						±		
	×											31				Fr	S	O					×	×			
		×										32				Fr	S	O						×		×	
	×	×										33				Fr	S	O					×	×			
	×	×										34				Fr	S	O	×				×				
	×	×					×	×				35			×	×	×	×	×	Fr	S	×		×		×	×
	×	×			×		×	×				36	Fr		×	×	×	×	×	S	O	×		×	×	×	×
												37				Fr	Je	Jl						±	±	±	
	×						×					38					×	Fr	O								
						×		×				39				×	×	Fr	×	S	O						
				×								40				Fr	×	×	Ag	×	O						
												41				×	×	Fr	Ag	O							
	×			×								42				Fr	S	O		×		×		×			
	×											43				Fr	Ag	S				×		×			
												44				Fr	S							×			
												45				Fr	S	O						×			
					×							46				Fr	S			×				×			
												47				Fr	×	S						×			
				×			×	×				48				Fr	×	×	S	×	O						
												49			Fr	Ag	O	×						×			
												50				Fr	S	O							×		
						×		×			×	51		×		×	×	Fr	×	S	O						
	×				×							52				Fr	Jl	Ag				+		+		+	

Distribution and Phenology		Weeds					MIS- Upland								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Kuhnia eupatorioides	1									Fl	Ag	O	×		
Lactuca canadensis	2	×	×	×	×					Fl	Jl	Ag		×	
Lactuca leucophaea integrifolia	3									Fl	Ag	S			
Lactuca ludoviciana	4	×			×			×		Fl	Jl	S		×	×
Lactuca Scariola	5	±	±	±	±			±		Fl	Jl	S	±		
Lactuca Scariola integrata	6	±	±	±	±			±		Fl	Jl	S	±		
Liatris cylindrica	7									Fl	Ag	S			
Liatris pycnostachya	8									Fl	Ag	S			
Liatris scariosa	9									×	Fl	Ag	×	S	
Matricaria Chamomilla	10		+		+					Fl	My	Ag			
Matricaria discoidea	11	+	+	+	+	+				Fl	My	Ag			
Parthenium integrifolium	12									±	Fl	Jl	±	Ag	
Parthenium repens	13									+	Fl	Ap	My		
Pluchea camphorata	14									Fl	Jl	Ag			
Polymnia canadensis	15									Fl	Jl	S			
Polymnia Uvedalia	16									Fl	Ag	S			
Prenanthes alba	17									±	Fl	S			
Prenanthes racemosa	18									Fl	Ag	S			±
Rudbeckia hirta	19	×		×	×			×	×	Fl	Je	Ag			
Rudbeckia laciniata	20						×			Fl	Jl	S			
Rudbeckia triloba	21	×			×	×		×	×	Fl	Ag	S	×		
Senecio aureus	22						±			±	Fl	Ap	My		±
Senecio aureus Balsamitae	23								Fl	Ap	My	±			
Senecio lobatus	24									Fl	My	Je			
Silphium integrifolium	25				±			±		Fl	Jl	Ag	±	±	
Silphium perfoliatum	26	±				±			Fl	Ag	S	±			
Silphium terebinthinaceum	27								Fl	±	±	Ag	±	S	
Solidago canadensis	28	×		×	×					Fl	Ag	S	×		
Solidago Drummondii	29									Fl	Ag	S			
Solidago lanceolata	30									Fl	Ag	S			
Solidago latifolia	31									Fl	Ag	S			
Solidago missouriensis	32									Fl	Ag	S			
Solidago nemoralis	33									Fl	Ag	S	×		
Solidago petiolaris	34									×	Fl	Ag	×	S	
Solidago radula	35							×		Fl	Jl	S			×
Solidago rigida	36								×	×	Fl	Ag	S		×
Solidago serotina	37	×		×	×					Fl	Jl	Ag	×		
Solidago speciosa	38									Fl	S	O	×		×
Solidago ulmifolia	39							×		Fl	Jl	Ag			
Sonchus asper	40	±	±		±					Fl	Ap	Ag			
Sonchus oleraceus	41	±	±		±					Fl	Ap	Ag			
Taraxacum officinale	42	±	±	±	±	±		±	±	Fl	Mr	O	±		
Verbesina encelioides	43									Fl	Jl				
Verbesina helianthoides	44							±	±	Fl	Je	Jl			±
Vernonia altissima	45									Fl	Ag	S			
Vernonia Baldwinii	46	×		×						Fl	Ag	S			
Vernonia fasciculata	47									Fl	Ag	S			
Vernonia noveboracensis	48	±		±	±			±		Fl	Ag	S	±	±	±
Xanthium canadense	49	±			±	±	±			Fl	Je	S			
Xanthium strumarium	50									Fl	Je	S			
Lobelia cardinalis	51									Fl	Ag	O			

SOURI											ILLINOIS													
Bluff			Lowland						River				Lowland									Bluff		Upland			
15	16	17	5	18	19	11	12	12	20	21	22	23	26	25	14	11	12	12	11	18	24	16	15	14	12	7	6
×												1				Fr	S	O					×		×		
					×		×					2			Fr	Ag	S	×						×			
				×								3				Fr	S	O						×			
	×				×		×		=			4			×	Fr	×	Ag	O				×		×			
±	±	±	±	±	±		±	±	±			5				Fr	±	±	Ag	±	O		±		±		±	
±	±	±	±	±	±		±	±	±			6				Fr	±	±	Ag	±	O		±		±		±	
×	×											7				Fr	S	O					×	×				
												8				Fr	S	O							×			
												9				Fr	S	O							×			
		+	+	+	+							10				Fr	Je	S										
				+								11				Fr	Je	S								+		
±												12				Fr	S	O					±		±			
												13				Fr	Je	Jl										
											×	14				Fr	Ag	S										
	×											15				Fr	Ag	O					×					
												16			×	Fr	S							×				
												17				Fr	O							±				
	±											18				Fr	S	O					±	±				
×					×							19				Fr	Ag	S		×				×	×			
	×							×				20			Fr	S	O	×					×				×	
				×	×							21			Fr	S	O	×		×				×	×			
										±		22			±	±	±	Fr	±	My	Je							
							±			±		23			Fr	±	±	Je	Jl									
												24		±	Fr	±	±	Jl	Ag									
	±				±	±						25				Fr	S	O		±		±			±			
							±			±		26				±	±	Fr	±	S	O							
					×	×						27				Fr	S	O							±			
												28			Fr	S	O	×		×								
×												29				Fr	S	O						×				
												30		×		Fr	×	×	S	O								
	×	×										31				Fr	S	O					×		×			
												32				Fr	S	O								×		
												33				Fr	S	O							×			
												34				Fr	S	O							×			
												35				Fr	S	O							×	×		
												36				Fr	S	O							×	×		
					×	×						37			Fr	S	O	×		×				×				
												38				Fr	O	N							×	×		
×												39				Fr	S	O						×				
												40			Fr	Jl	S	±								±		
												41			Fr	Jl	S	±								±		
±	±	±	±	±	±		±	±				42			Fr	Mr	±	±	O	±	±	±			±	±		
												43				Fr	Ag	S		×								
±												44				Fr	Ag	S						±		±		
												45				Fr	×	S	O				×		×			
												46				Fr	S	×	O									
								×	×			47	×			×	×	Fr	S	O					×			
		±		±	±		±	±				48				±	±	Fr	S	O					±	±		±
							±					49			Fr	±	±	±	±	Ag	D							
												50				Fr	Ag	D										±
												51		*	*	*	Fr	S	*	N								

Distribution and Phenology		Weeds					MIS- Upland								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Lobelia inflata	1			×					×	Fl	Jl	Ag	×		
Lobelia leptostachys	2	×						×	×	Fl	Jl	Ag			
Lobelia syphilitica	3					×			Fl	Ag	O	×			
Campanula americana	4									Fl	Jl	S			
Specularia perfoliata	5	±			±					Fl	My	Je			
Androsace occidentalis	6	|		|	|				|	Fl	Mr	My	|		
Dodecatheon Meadia	7									Fl	|	Ap	My		|
Lysimachia stricta	8									Fl	Jl	Ag			
Samolus Valerandi americana	9					×				Fl	Jl	Ag			
Steironema ciliatum	10									Fl	Jl	Ag			
Steironema lanceolatum	11									Fl	Jl	Ag			
Diospyros virginiana	12							*		*	Fl	My	Je		*
Forestiera acuminata	13									Fl	Ap				
Fraxinus americana	14						*	*		Fl	Ap				*
Fraxinus viridis	15						*			Fl	Ap				
Amsonia Tabernaemontana	16									Fl	Ap	My			
Apocynum androsaemifolium	17								±	Fl	My	Je	±		
Apocynum cannabinum	18					±		±		Fl	Je	Jl		±	±
Acerates viridiflora	19									±	Fl	Je	Jl		
Asclepias Cornuti	20	×			×					Fl	Je	Ag			
Asclepias incarnata	21									Fl	Je	Jl			
Asclepias obtusifolia	22	×			×					Fl	Je	Jl			
Asclepias purpurascens	23							×		Fl	Je	Jl		×	×
Asclepias quadrifolia	24									+	Fl	My	Je		
Asclepias tuberosa	25	×							×	×	Fl	Je	×	Ag	
Asclepias verticillata	26								×	×	Fl	Jl	×	Ag	
Asclepiodora viridis	27									×	Fl	Jl	Ag		
Enslenia albida	28						×	×		Fl	Je	Jl		×	
Gonolobus carolinensis	29							±		±	Fl	My	Je		
Gentiana Andrewsii	30									Fl	S	O			
Sabbatia angularis	31	×							×	×	Fl	Ag	×	S	
Phlox divaricata	32						*‡			Fl	Ap	My		*‡	*‡
Phlox pilosa	33									Fl	My	Je	*‡		
Polemonium reptans	34						+			Fl	Ap	My		+	+
Ellisia Nyctelea	35	+	+		+	+	+			Fl	Ap	My			
Hydrophyllum appendiculatum	36							+		Fl	Ap	My			
Hydrophyllum canadense	37									Fl	Ap	My			
Hydrophyllum virginicum	38									Fl	Ap	My			
Phacelia bipinnatifida	39									Fl	Ap	My			
Phacelia Purshii	40									Fl	Ap	My			
Cynoglossum virginicum	41									Fl	My	Jl		±	±
Echinospermum virginicum	42							×		Fl	Jl				×
Heliotropium indicum	43									Fl	Ag	O			
Heliotropium tenellum	44									×	Fl	Je	Jl		
Lithospermum arvense	45	+		+	+					Fl	Ap	My			
Lithospermum canescens	46									+	Fl	Ap	My		
Lithospermum latifolium	47									Fl	Mr	Je			
Onosmodium carolinianum	48									×	Fl	Jl	Ag		
Convolvulus arvensis	49	×			×					Fl	Je	S			
Convolvulus Sepium	50	×			×		×			Fl	My	S			
Cuscuta arvensis	51									Fl	Jl	Ag			

SOURI												ILLINOIS															
Bluff			Lowland						River				Lowland									Bluff		Upland			
15	16	17	5	18	19	11	12	12	20	21	22	23	26	25	14	11	12	12	11	18	24	16	15	14	12	7	6
												1			Fr	Ag	S	×						×			
												2				Fr	Ag	S								×	
				×		×		×				3		×	Fr	×	×	S	×	O							
	×			×								4				Fr	S	O	×			×		×			
												5				Fr	Jl	Ag								±	
|												6				Fr	Ap	My					|			|	
												7				Fr	My	Je						|			
												8				Fr	S	O	×								
								×	×		×	9	×			×		Fr	×	Ag	S						
							×	×				10		×	×	×	×	Fr	×	Ag	S						
							×	×				11		×	×	×	×	Fr	×	Ag	S	×					
	*	*										12				Fr	S	N						*		*	
								*				13			*	*	*	Fr	My								*
	*	*					*					14				Fr	Ag	*	D					*		*	*
*								*				15				*	*	Fr	Ag	D							*
												16				±	±	Fr	±	Ag	S						
												17				Fr	Ag	S									
		±		±	±		±					18				±	Fr	±	Ag	S				±	±		±
												19				Fr	Ag	S						±		±	
				×			×					20			Fr	Ag	O	×								×	
								×				21			Fr	×	×	Ag	O								
				×			×					22			Fr	Ag	O	×		×							
	×			×			×					23			Fr	Ag	O	×		×				×		×	
	+											24				Fr	Jl	Ag				+		+		+	
												25				Fr	Ag	O							×		
×	×											26				Fr	Ag	O				×	×		×		
												27				Fr	S	O									
							×					28			Fr	Ag	O	×									×
												29				Fr	Ag	S								±	
												30				Fr	O	N						×			
												31				Fr	S	O								×	
	*‡											32				Fr	My	Je				*‡		*‡			*‡
*‡	*‡											33				Fr	Je	Jl				*‡	*‡	*‡	*‡	*‡	
	+	+										34				Fr	My	Je				+		+			+
			+									35			Fr	My	Je	+									
	+	+										36				Fr	Je	Jl				+		+			
	+	+										37				Fr	Je	Jl				+					
	+	+										38				Fr	Je	Jl				+					
												39				Fr	My	Je				+					
												40			Fr	Je	Jl	+	+	+	+	+					
												41			Fr	Ag	S	±						±			
	×											42				Fr	O					×		×		×	
								×				43	×	Fr	×	×	S	O						×			×
												44				Fr	S										
					+							45				Fr	Je	Jl			+						
+	+											46				Fr	Je	Jl						+		+	
	+			+	+							47				Fr	Ap	Jl		+		+					
												48				Fr	Ag	S						×			
					×							49				Fr	Jl	O	×	×							
							×	×				50				Fr	×	×	Je	O				×			×
								×				51	×			×	×	Fr	S	O							

Distribution and Phenology		Weeds					MIS- Upland									
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Cuscuta chlorocarpa	1									Fl	Jl	Ag				
Cuscuta compacta	2									Fl	Jl	Ag				
Cuscuta glomerata	3									Fl	Jl	Ag				
Cuscuta Gronovii	4									Fl	Ag	S			×	
Ipomoea hederacea	5	×	×		×					Fl	Je	S				
Ipomoea lacunosa	6									Fl	Jl	S				
Ipomoea pandurata	7						×			Fl	Jl	S				
Ipomoea purpurea	8	×	×		×					Fl	Je	S				
Datura Stramonium	9	×	×		×					Fl	Je	O	×			
Datura Tatula	10	×	×		×					Fl	Je	O	×			
Nicandra physaloides	11		+							Fl	Ap	Jl				
Physalis angulata	12									Fl	Je	Jl	×			
Physalis philadelphica	13									×	×	Fl	Ag	S	×	
Physalis pubescens	14									Fl	Je	Ag				
Physalis subglabrata	15									Fl	My	S			±	
Solanum carolinense	16	±	±	±	±			±		Fl	Ap	S	±			
Solanum elaeagnifolium	17									Fl	Je	Jl				
Solanum nigrum	18		×		×		×	×		Fl	Je	×	S	×	×	
Solanum rostratum	19	+	+	+						Fl	Je	Jl	+			
Conobaea multifida	20	×				×				Fl	My	Jl				
Gerardia aspera	21									Fl	Ag	S				
Gerardia auriculata	22									Fl	S	O				
Gerardia tenuifolia	23								×	×	Fl	Ag	×	O	×	
Gerardia tenuifolia asperula	24									Fl	Ag	O				
Gratiola sphaerocarpa	25					×				Fl	Je	Ag				
Gratiola virginiana	26									Fl	Je	Ag				
Herpestis rotundifolia	27									Fl	Jl	O				
Ilysanthes riparia	28					±				Fl	My	Jl				
Linaria vulgaris	29									Fl	Je	S				
Mimulus alatus	30					×				Fl	Jl	S				
Mimulus ringens	31								Fl	Jl	S	×				
Pedicularis canadensis	32						+		+	Fl	Ap	My			+	
Pentstemon laevigatus Digitalis	33							×		Fl	Jl	S	×			
Pentstemon pubescens	34							+	+	+	Fl	My	Je		+	
Scrophularia nodosa marylandica	35									Fl	My	O		±		
Seymeria macrophylla	36								×	Fl	Jl	S				
Verbascum Blattaria	37	±			±					Fl	Je	Ag	±			
Verbascum Thapsus	38	*	*	*	*				*	Fl	Je	S	*			
Veronica arvensis	39	|		|					|	Fl	Ap	My	|		
Veronica peregrina	40	±	±	±		±			Fl	Ap	My	±				
Veronica virginica	41							±		Fl	Je	S				
Aphyllon uniflorum	42									Fl	Ap	My		|	|	
Utricularia biflora	43									Fl	Jl	Ag				
Utricularia vulgaris	44									Fl	Jl	Ag				
Tecoma radicans	45	*			*		*	*		Fl	Je	Ag				
Ruellia ciliosa	46								Fl	±	Je	Ag	±			
Ruellia strepens	47						±			Fl	Je	Ag				
Lippia lanceolata	48					×			Fl	Je	S	×				
Phryma leptostachya	49							×		Fl	Je	Jl		×	×	
Verbena angustifolia	50								Fl	±	My	S	±			
Verbena Aubletia	51							Fl	±	±	Ap	S	±			

SOURI												ILLINOIS																
Bluff			Lowland						River				Lowland									Bluff		Upland			
15	16	17	5	18	19	11	12	12	20	21	22	23	26	25	14	11	12	12	11	18	24	16	15	14	12	7	6
								×				1	×			×	×	Fr	S	O							
								×				2	×			×	×	Fr	S	O							
								×				3	×			×	×	Fr	S	O							
								×				4				×	×	Fr	S	O							
				×	×							5				Fr	×	×	Jl	×	O				×		
												6	×	×		×	×	Fr	×	A	O						
	×				×		×	×				7			×	Fr	×	×	Ag	O		×					×
								×	×			8				Fr	×	×	Ag	O							
				×	×		×		9	×	×	×			Fr	×	×	×	Ag	×	D				×	×	
				×	×		×		10	×	×	×			Fr	×	×	×	Ag	×	D				×	×	
												11				Fr	My	Ag								+	
	×			×							12	×			Fr	S	O	×		×						×	
	×			×	×							13				Fr	Ag	S	×	×	×	×					
												14			Fr	Jl	Ag	×			×						
	±											15				Fr	Je	S						±			
	±	±		±	±		±	±		16	±	±			Fr	Jl	±	±	D	±	±	±			±	±	
												17				Fr	Ag	O		×							
	×	×	18	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	Fr	×	Ag	N	×
				+	+							19				Fr	Jl	O		+	+				+	+	
			×					×	×		×	20	×	×		Fr	×	Ag	S	×								
												21			Fr	S	O	×					×			×	
												22				Fr	O	N						×			
												23				Fr	S	N					×	×		×	
												24				×	×	Fr	×	S	N						
			×								×	25	×	×		×	×	Fr	×	Ag	S						
											×	26	×	×		×	×	Fr	×	Ag	S						
												27				×	Fr	Ag	O								×
			±			±						28	±		Fr	±	Je	Ag	±								
												29				Fr	S	O		×							
			×								×	30		×	Fr	×	×	S	O								
			×			×						31				Fr	S	O	×								
												32				Fr	My	Je						+			
	×	×					×					33		×	Fr	×	×	×	×	S	O						×
	+											34				Fr	Je	Jl						+			
	±				±		±					35			Fr	Je	N	±			±		±		±		
	×	×										36				×	Fr	×	×	S	O	×				×	×
				±								37			Fl	Ag	S	±		±							
*	*			*	*		*	*			38	*			Fr	Ag	O	*		*	*	*	*		*	*	
												39			Fr	My	Je	|							|	|	
			±	±		±					±	40				Fr	±	Je	Jl	±							
	±			±	±			±				41		Fr	Ag	±	±	O	±	±	±	±		±			
												42				Fr	My	Je						|			
												43			Fr	×	Ag	S	×								
												44			Fr	×	Ag	S	×								
*				*	*		*	*				45			Fr	Ag	*	*	D	*	*	*	*				*
±												46			Fr	Jl	S	±					±			±	
	±	±										47				Fr	Jl	S				±		±			±
			×					×	×		×	48	×	×	Fr	×	×	Jl	×	O							
					×							49				Fr	Ag	S						×			
±												50				Fr	Je	N								±	
±	±											51				Fr	My	N								±	

Distribution and Phenology		Weeds					MIS- Upland								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Verbena bracteosa	1				×					Fl	Je	S			
Verbena hastata	2	×				×				Fl	Jl	Ag			
Verbena stricta	3	±		±	±					Fl	Je	S	±		
Verbena urticaefolia	4	±		±	±					Fl	Jl	S	±		
Blephilia ciliata	5	+						+	Fl	+	My	Je	+		+
Blephilia hirsuta	6									Fl	Je	Jl			
Brunella vulgaris	7	±	±	±	±	±	±	±	Fl	±	Je	Ag	±	±	±
Cunila Mariana	8								±	Fl	Jl	S	±		
Hedeoma pulegioides	9			×				×	×	Fl	Jl	Ag	×		×
Isanthus caeruleus	10								×	×	Fl	Jl	×	Ag	
Lamium amplexicaule	11		+							Fl	Mr	Jl			
Leonurus Cardiaca	12		±							Fl	My	Jl			
Lophanthus nepetoides	13						×			Fl	Jl	S			
Lycopus sinuatus	14					×				Fl	Jl	S			
Lycopus virginicus	15					×				Fl	Jl	S			
Marrubium vulgare	16		±							Fl	My	Jl			
Melissa officinalis	17		±							Fl	Je	Ag			
Mentha canadensis	18									Fl	Ag	S			
Monarda Bradburiana	19							±	±	Fl	My	Jl			
Monarda fistulosa	20	*‡			*‡		*‡			Fl	Je	S	*‡	*‡	*‡
Monarda punctata	21								×	×	Fl	Je	S		
Nepeta Cataria	22		×							Fl	Je	Ag			
Nepeta Glechoma	23						±			Fl	Ap	S			
Physostegia virginiana	24									Fl	Ag	S			
Pycnanthemum lanceolatum	25							±		Fl	Jl	S		±	±
Pycnanthemum linifolium	26							±		Fl	Jl	S		±	±
Pycnanthemum muticum pilosum	27							±		Fl	Jl	S			±
Scutellaria canescens	28									Fl	Je	Ag			
Scutellaria lateriflora	29									Fl	Jl	Ag			
Scutellaria parvula	30									|	Fl	Ap	My		
Scutellaria versicolor	31						×	×		Fl	Jl	S		×	×
Stachys aspera	32									Fl	Jl	Ag			
Stachys palustris	33					—				Fl	Jl	S			
Teucrium canadense	34									Fl	Je	Ag			
Plantago lanceolata	35	±	±							Fl	My	Ag	±		
Plantago patagonica aristata	36	±	±		±				±	Fl	My	Jl	±		±
Plantago pusilla	37			|						Fl	Ap	My	|		
Plantago Rugelii	38	±	±	±	±	±				Fl	Je	Ag	±		
Oxybaphus nyctagineus	39				×			×		Fl	Je	Ag			
Anychia dichotoma	40					×				Fl	Jl	Ag			
Acnida tuberculata	41									Fl	Ag	S			
Amaranthus albus	42									Fl	Je	Jl			
Amaranthus blitoides	43									Fl	Je	Jl			
Amaranthus paniculatus	44	×								Fl	Jl	Ag			
Amaranthus retroflexus	45	×								Fl	Jl	Ag			
Amaranthus spinosus	46	×	×		×					Fl	Jl	S			
Atriplex patulum hastatum	47	=			=					Fl	S				
Chenopodium album	48	×			×					Fl	Jl	S			
Chenopodium ambrosioides	49	×								Fl	Jl	S			
Chenopodium ambrosioides anthelminticum	50	×								Fl	Jl	S			
Chenopodium hybridum	51	×								Fl	Jl	S			

SOURI												ILLINOIS															
Bluff			Lowland						River				Lowland									Bluff		Upland			
15	16	17	5	18	19	11	12	12	20	21	22	23	26	25	14	11	12	12	11	18	24	16	15	14	12	7	6
					×							1				Fr	Jl	N			×					×	
	×					×		×				2		×		×	×	Fr	×	S	O	×					
							±					3			Fr	Ag	N	±							±		
				±	±		±					4			Fr	Ag	N	±		±	±				±	±	
+												5				Fr	Jl	Ag					+	+		+	
	×	×					×	×				6				Fr	×	Ag	S					×			
	±	±	±	±			±	±				7	Fr	Jl	O	±	±	±	±	±		±		±	±	±	±
												8				Fr	S	O						±			
												9				Fr	S	O						×	×		
												10				Fr	S	O						×	×		
				+	+							11				Fr	A p	Jl									
												12				Fr	Ag	S									
								×				13				Fr	×	S	O								×
			×			×						14		×	Fr	×	S	O	×								
			×			×						15		×	Fr	×	S	O	×								
												16				Fr	Jl	S									
												17				Fr	Jl	S									
												18	±	±	Fr	±	±	S	±	O							
												19				Fr	Ag	S						±			
±	±			*‡	*‡		*‡					20			Fr	Ag	N	*‡		*‡		*‡		*‡	*‡		*‡
×												21				Fr	Ag	N						×		×	
												22				Fr	Jl	N									
	±											23				Fr	My	O				±					±
												24			×	Fr	×	S	O								×
												25				Fr	Ag	O						+			
	±			±	±							26				Fr	Ag	O						±			
												27				Fr	Ag	N						±			
	—											28				Fr	Jl	S				—					
								×				29		×	Fr	×	×	S	O								×
												30				Fr	Je	Jl									
				×								31				Fr	Ag	O						×			×
								—				32		—	Fr	—	Ag	S	—								
		—						—				33			Fr	—	—	S	—	O		—					
								×				34	×	×	Fr	×	×	Ag	×	O							
				±	±		±					35				Fr	Jl	O		±							
±				±	±		±				36	±			Fr	Je	S	±		±	±			±	±	±	
												37				Fr	My	Je									
	±			±	±		±	±				38			Fr	Jl	S	±		±	±			±	±	±	
	×		×	×	×							39			Fr	Jl	O	×				×				×	
			×					×				40				Fr	×	Ag	S								
								×	×		×	41	×	×	Fr	×	×	×	×	S	O						
				×								42			Fr	Ag	S	×		×						×	
				×								43				Fr	Ag	S		×							
												44				Fr	Ag	O									
				×			±					45				Fr	×	×	S	×	O				×		
												46				Fr	S	O									
							=					47				Fr	O	=							=	=	
				×			×					48					×	×								×	
											49	×				Fr	Ag	O									
				×						×	50	×				Fr	Ag	O		×							
												51				Fr	Ag	O									

Distribution and Phenology		Weeds					MIS-								
							Upland								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Chenopodium murale	1	—								Fl	Je				
Cycloloma platyphyllum	2									Fl	Jl	Ag			
Salsola Kali Tragus	3									Fl	Ag				
Phytolacca decandra	4				±		±	±	±	Fl	My	Ag	±		±
Fagopyrum esculentum	5	—								Fl	Ag				
Polygonum acre	6									Fl	Jl	S			
Polygonum aviculare	7	×	×							Fl	Jl	S			
Polygonum dumetorum scandens	8									Fl	Je	Ag		×	
Polygonum erectum	9				×					×	Fl	My	Ag		
Polygonum Hartwrightii	10									Fl	Je	S			
Polygonum Hydropiper	11									Fl	Ag	S			
Polygonum hydropiperoides	12									Fl	Jl	S			
Polygonum lapathifolium	13									Fl	Je	S			
Polygonum lapathifolium incarnatum	14									Fl	Je	S			
Polygonum Muhlenbergii	15									Fl	Je	S			
Polygonum Persicaria	16									Fl	Ag	S			
Polygonum virginicum	17									Fl	Jl	S		±	±
Rumex Acetosella	18	±	±	±	±	±				Fl	Ap	Ag	±		
Rumex altissimus	19									Fl	My	Jl			
Rumex crispus	20	±	±	±	±					Fl	My	Jl			
Rumex maritimus	21									Fl	My	Jl			
Rumex obtusifolius	22	±	±							Fl	Je	Jl	±		
Rumex verticillatus	23									Fl	Je	Ag			
Aristolochia tomentosa	24									Fl	My	Je			
Asarum canadense	25									Fl	Ap	My			
Saururus cernuus	26									Fl	Je	Jl			
Lindera Benzoin	27									Fl	Mr	Ap			
Sassafras officinale	28	*							*	*	Fl	Ap	My		*
Comandra umbellata	29								|	|	Fl	Ap	My		
Acalypha caroliniana	30									Fl	Jl	Ag			
Acalypha virginica	31	×	×		×			×		Fl	Jl	Ag		×	×
Acalypha virginica gracilens	32									Fl	Jl	Ag			
Croton capitatus	33			×						Fl	Jl	Ag	×		
Croton glandulosus	34	×								Fl	Jl	Ag	×		
Croton monanthogynus	35	×								Fl	Ag	S	×		
Euphorbia corollata	36							+		Fl	My	Ag			
Euphorbia dentata	37	×		×						Fl	Je	O	×		
Euphorbia glyptosperma	38									Fl	Jl	Ag			
Euphorbia humistrata	39									Fl	Ag	N			
Euphorbia maculata	40	×	×		×					Fl	Je	S			
Euphorbia obtusata	41									Fl	Ag	S			
Euphorbia Preslii	42	×		×	×			×	×	Fl	Je	Ag	×		×
Euphorbia serpens	43									Fl	Jl	N			
Boehmeria cylindrica	44									Fl	Je	Ag			
Cannabis sativa	45	±	±							Fl	Je	Ag			
Celtis mississippiensis	46									Fl	My	Je			
Celtis occidentalis	47						*			Fl	Ap	My			
Celtis pumila	48									Fl	Ap	My			
Humulus Lupulus	49		±		±					Fl	Je	Jl		±	±
Laportea canadensis	50						—			Fl	Je				
Morus rubra	51				*		*	*		Fl	My	Je			*

SOURI												ILLINOIS																			
Bluff			Lowland						River				Lowland										Bluff		Upland					
15	16	17	5	18	19	11	12	12	20	21	22	23	26	25	14	11	12	12	11	18	24	16	15	14	12	7	6				
												1				Fr	Jl			—											
											2	×				Fr	Ag	O			×											
												3				Fr	S	D		×												
	±	±		±			±					4				Fr	±	±	Jl	S			±		±						
												5				Fr	S														
												6				×	×	Fr	Ag	O											
								×			7	×			Fr	Ag	O	×								×					
	×				×		×	×				8			Fr	×	×	×	×	Jl	N	×						×			
											9	×				Fr	Je	S													
						±		±	±			10	±	±	Fr	±	±	Jl	O													
								×			=	11	×	×		×	×	Fr	×	O												
								×	×		=	12	×	×	Fr	×	×	Ag	×	S												
						±		±	±			13	±	±		±	±	Fr	Jl	O			±									
												14				±	Fr	Jl	±	N												
												15		±		±	Fr	Jl	±	N												
									×			16				Fr	×	S	O													
								±				17				Fr	±	S	O						±							
	±				±		±	±				18				Fr	±	±	My	±	S					±						
								±				19				Fr	±	±	Jl	S												
				±					±			20				Fr	±	Jl	S	±												
												21				Fr	Jl	S					±									
				±								22				Fr	Ag	±	S	±												
						×						23				×	Fr	Ag	×	S												
	±	±										24				Fr	S	O	±				±		±							
	+	+										25				Fr	My	Je	+				+		+							
								+				26	±	±		±	Fr	Ag	±	S												
	*	*										27				Fr	Jl	Ag					*									
	*	*										28				Fr	Jl	Ag					*		*		*					
												29				Fr	My	Je														
	×											30				Fr	Ag	S														
	×											31				Fr	Ag	S					×		×		×					
	×	×										32				Fr	Ag	S					×									
												33				Fr	S	×	O	×						×						
												34				Fr	S	×	O							×						
												35				Fr	S	×	O							×						
	+											36				Fr	Jl	Ag					+		+							
				×	×							37				Fr	Ag	×	N	×						×						
												38				Fr	×	Ag	S													
				×							×	39				Fr	×	S	N	×											×	
				×	×							40				Fr	Jl	N		×												
												41				Fr	S	×	O				×		×							
	×		×	×	×		×				×	42			Fr	Jl	O	×	×	×			×		×	×						
				×	×							43			Fr	Ag	N	×		×	×											
												44			Fr	S	×		×						×							
												45			Fr	Ag	S	±														
								*				46		Fr	*	*	*	*	*	S	N	*									*	
	*	*										47			*	Fr	S	*	N												*	*
*												48				Fr	S	N					*									
		±			±							49				Fr	S	±	O						±						±	
								—				50				Fr	—	Ag	S						—							
	*	*						*				51				*	*	*	*	Fr	Je										*	*

Distribution and Phenology		Weeds					MIS-								
							Upland								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Pilea pumila	1									Fl	My	Je			
Ulmus americana	2						*			Fl	Mr	Ap			
Ulmus fulva	3							*		Fl	Mr	Ap			*
Urtica gracilis	4									Fl	Ag	S			
Platanus occidentalis	5						*		Fl	My	*	*			
Carya alba	6							*	*	Fl	My				*
Carya amara	7									Fl	My				
Carya olivaeformis	8									Fl	My				
Carya porcina odorata	9							*	*	Fl	My				*
Carya tomentosa	10							*	*	Fl	My				*
Juglans cinerea	11									Fl	My				*
Juglans nigra	12									Fl	My				*
Betula nigra	13						*			Fl	Ap	My			
Carpinus caroliniana	14						*			Fl	Ap				
Corylus americana	15									Fl	Ap			*	
Ostrya virginica	16							*		Fl	Ap				
Quercus alba	17						*	*	*	Fl	My				*
Quercus bicolor	18									Fl	My				
Quercus coccinea tinctoria	19						*	*	*	Fl	Ap	My			*
Quercus imbricaria	20							*		Fl	Ap	My			*
Quercus macrocarpa	21						*	*		Fl	My				
Quercus macrocarpa olivaeformis	22									Fl	My				
Quercus Muhlenbergii	23							*	*	*	Fl	Ap	My		*
Quercus nigra	24							*	*	Fl	Ap	My			*
Quercus palustris	25									Fl	Ap	My			
Quercus rubra	26							*		Fl	Ap	My			*
Quercus stellata	27							*	*	Fl	Ap	My			*
Quercus Schneckii	28							*	*	Fl	Ap	My			*
Populus monilifera	29									Fl	Ap	My			
Salix amygdaloides	30									Fl	Ap				
Salix amygdaloides × nigra	31									Fl	Ap				
Salix cordata × sericea	32									Fl	Ap				
Salix longifolia	33									Fl	Ap	My			
Salix nigra	34						*			Fl	Ap	My			
Salix sericea	35									Fl	Ap	My			
Juniperus virginiana	36									Fl	Ap				
Elodea canadensis	37									Fl	Je				
Cypripedium pubescens	38							+		Fl	My			+	+
Habenaria virescens	39									Fl	Jl				
Iris versicolor	40								Fl	My	Je	±			
Sisyrinchium albidum	41							+	+	+	Fl	My	+		+
Sisyrinchium anceps	42							+	+	+	Fl	My	+		+
Agave virginica	43									*‡	Fl	Je			
Hypoxis erecta	44									Fl	Ap	My			|
Dioscorea villosa	45								±	Fl	Je	Jl		±	
Allium cernuum	46	+		+				+		Fl	Jl	Ag	+		
Allium vineale	47	+								Fl	Ap	My			
Allium stellatum	48									—	Fl	S	O		
Asparagus officinalis	49		±		±					Fl	My				
Camassia Fraseri	50									|	Fl	Ap			|
Erythronium albidum	51						|			Fl	Ap				

SOURI									ILLINOIS															
Bluff			Lowland						River				Lowland									Bluff		Upland			
15	16	17	5	18	19	11	12	12	20	21	22	23	26	25	14	11	12	12	11	18	24	16	15	14	12	7	6
	±											1				Fr	Ag	S				±					
	*							*				2	Fr	*	*	*	*	Ap	*	*	My	*					*
	*						*					3			Fr	Ap	My	*	*			*		*			
												4			Fr	×	S	O	×								
								*				5			Fr	*	Jl	D	*								*
												6				Fr	S	O					*	*		*	
												7			*	Fr	S	O									*
								*				8			*	*	Fr	S	O								*
												9				Fr	S	O									
												10				Fr	S	O									*
		*										11				Fr	S	O				*	*				
		*					*	*				12				Fr	S	N					*				
								*	*	*		13	*	*	*	*	*	Fr	*	Ag	N						*
	*	*										14				Fr	Ag	S				*					*
	*	*										15				Fr	S					*					*
	*	*										16			*	Fr	Ag	S				*	*				
		*										17				Fr	Ag	S					*				
								*				18		*	*	Fr	*	Ag	*	S							
	*	*										19				Fr	S	*	O			*	*				
							*					20				Fr	S	*	O			*					
	*	*					*	*				21			*	Fr	*	*	*	S	O	*	*				*
								*				22			*	Fr	*	*	*	S	O	*	*				*
*	*	*										23			Fr	Ag	S	*	*				*				
												24				Fr	S	O					*				
								*				25		*	Fr	*	*	S	O								
												26			Fr	S	O	*	*				*		*		
												27				Fr	S	O					*		*		
												28				Fr	S	O					*		*		
	*					29	*	=	*	=	*		*	*	*	*	Fr	Je	*									
												30	*	*	*	*	Fr	Je	Jl								
												31		*	*	Fr	Je	Jl									
							*		*			32		*	*	*	Fr	Je	*	Jl							*
						33	*	=	*	=	*			*	*	*	Fr	Je	*	Jl							
							*		*			34		*		*	Fr	Je	Jl								*
							*					35		*		*	Fr	My	Je								
*‡												36				Fr	S	O					*‡				
												37				±											
		+										38				Fr	Jl	Ag					+				
												39				Fr	Ag					—	—				
					±		±					40		±		±	Fr	Jl	Ag								
												41				Fr	Je	Jl					+	+	+	+	
												42				Fr	Je	Jl					+		+	+	
*‡												43				Fr	Ag	S					*‡			*‡	
												44				Fr	My	Je									
	±				±							45				Fr	S	±			±	±		±		±	
				+				+				46			+	+	+	+	Fr	Ag				+	+	+	
												47				+	+	Fr	Je	+	Jl				+		
		=										48				Fr	O										
				±	±							49				Fr	Ag	S		±	±						
												50				Fr	My	Je									
												51				Fr		My									

Distribution and Phenology		Weeds					MIS- Upland								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Hemerocallis fulva	1		±		±					Fl	Je				
Lilium canadense	2									Fl	Je				
Nothoscordum striatum	3								|	|	Fl	Ap			
Polygonatum giganteum	4							±		Fl	±	My	Je		±
Smilacina racemosa	5							±		Fl	±	My	Je		±
Smilax ecirrhata	6									Fl	My			±	
Smilax herbacea	7						±			Fl	My	±	Je	±	±
Smilax hispida	8						±			Fl	My	±	Je	±	±
Trillium erectum	9									Fl	Ap	My			
Trillium recurvatum	10						|	|		Fl	Ap	|	My	|	|
Trillium sessile	11						|	|		Fl	Ap	|	My	|	|
Uvularia perfoliata	12						+	+			Fl	Ap				
Heteranthera graminea	13									Fl	Jl	—			
Heteranthera limosa	14									Fl	Jl	—			
Heteranthera reniformis	15									Fl	Jl				
Pontederia cordata	16									Fl	Je	±	S		
Commelina communis	17		±				±			Fl	Ap	±	S		
Commelina virginica	18						±			Fl	±	±	Jl	O	
Tradescantia virginica	19						±	±		Fl	±	My	±	Jl	±
Juncus acuminatus	20									Fl	My	Je			
Juncus acuminatus robustus	21									Fl	My	Je			
Juncus dichotomus	22									Fl	My	Je			
Juncus marginatus	23									Fl	Je	Jl			
Juncus nodosus megacephalus	24									Fl	Je	Jl			
Juncus tenuis	25	±	±	±	±	±			±	Fl	My	Ag			±
Luzula campestris	26									Fl	Ap	My			+
Sparganium eurycarpum	27									Fl	My	Jl			
Sparganium simplex androcladum	28									Fl	My	Jl			
Typha latifolia	29								Fl	My	Je	±			
Acorus Calamus	30									Fl	Ap	My			
Arisaema Dracontium	31						±	±	Fl	Ap	±	±	Je	±	±
Arisaema triphyllum	32						±	±	Fl	Ap	±	±	Je	±	±
Peltandra undulata	33									Fl	My	Je			
Lemna minor	34														
Lemna perpusilla	35											—			
Lemna perpusilla trinervis	36														
Lemna trisulca	37														
Spirodela polyrrhiza	38											×			
Wolffia punctata	39											—			
Alisma Plantago	40				±				Fl	Jl	S	±			
Echinodorus radicans	41									Fl	Jl	Ag			
Echinodorus rostratus	42									Fl	Jl	Ag			
Sagittaria calycina	43									Fr	Je	±	S		
Sagittaria graminea	44									Fr	Je	±	S		
Sagittaria heterophylla	45									Fr	Je	±	S		
Sagittaria variabilis	46									Fr	Je	±	S		
Sagittaria variabilis latifolia	47									Fr	Je	±	S		
Potamogeton hybridus	48									Fl	Ap	My			
Potamogeton illinoensis	49									Fl	Ap	My			
Carex cephalophora	51							+		Fl	My	Je			+
Carex conjuncta	51							+		Fl	My	Je			+

SOURI											ILLINOIS															
Bluff			Lowland						River					Lowland									Bluff		Upland			
15	16	17	5	18	19	11	12	12	20	21	22	23	26	25	14	11	12	12	11	18	24	16	15	14	12	7	6
				±								1								±							
												2				Fr	Jl	Ag		+					+		
|												3				Fr	My							|			
	±	±		±	±							4				Fr	Jl	Ag				±		±			
	±	±		±	±							5				Fr	Je	Jl				±		±			
	±				±							6				Fr	S	O				±					
	±			±								7				Fr	Ag	S	±			±		±			±
	±			±								8				±	±	Fr	±	Ag	O			±			±
	|											9				Fr	Je	Jl									
	|											10			|	Fr	Je	Jl	|			|		|			|
	|											11			|	Fr	Je	Jl	|			|		|			|
+	+											12				Fr	My	Je				+		+				+
					—							13				—	Fr	Ag	—								
					—							14	—			—	Fr	Ag	—								
												15	—			—	Fr	Ag									
												16				Fr	Jl	S	±								
	±	±			±							17				Fr	±	Ap	N								±
	±	±			±							18				Fr	±	Ag	N	±							±
±	±		±	±		±	±					19	Fr	Je	Ag	±	±	±	±	±	±	±		±	±	±	±
					+							20			Fr	+	Je	Jl	+								
					+							21			Fr	+	Je	Jl	+								
					—							22				Fr	Jl	Ag									
												23		—	Fr	—	Jl	Ag	—								
										×	24	×				Fr	Jl	S									
		±						=		=	25				Fr	Je	S	±							±		
											26					Fr	Je	Jl	+					+		+	
					±						27	±		Fr	±	Jl	Ag	±									
											28	±		Fr	±	Jl	Ag	±									
		±			±						29	±	±	Fr	±	Jl	O	±									
											30		±	Fr	±	Jl	Ag	±									
±	±										31			±	±	Fr	S	O				±		±			±
±	±										32			±	±	±	Fr	S	O			±		±			±
					+						33	+		Fr	+	Ag	S	+									
		—									34				—	Fr	Je										
		—									35				—	Fr	Ag										
											36				—	Fr	Ag										
											37				—												
					×						38					×				×							
											39				—												
		±			±		±				40	±	Fr	±	±	S	O	±									
											41			Fr	×	Ag	S		×								
											42	±	±	Fr	±	Ag	S										
					±						43	±	±	Fr	±	Jl	Ag	±									
					±						44	±	±	Fr	±	Jl	Ag	±									
					±						45	±	±	Fr	±	Jl	Ag	±									
		±			±						46	±	±	±	±	Fr	Jl	±	Ag								
					±						47	±	±	Fr	±	Jl	Ag	±									
											48			Fr	±	Je	Jl	±									
											49			Fr	±	Je	Jl	±									
	+										50				Fr	Jl	Ag		+					+		+	
	+						+				51			Fr	Jl	Ag	+		+					+			

Distribution and Phenology		Weeds					MIS- Upland								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Carex Crus-Corvi	1									Fl	My	Je			
Carex Davisii	2									Fl	Ap	My			
Carex granularis	3						+			Fl	Ap	My			
Carex gravida	4									Fl	Ap	My			
Carex grisea	5								+	Fl	Ap	My	+		
Carex Jamesii	6							+		Fl	Ap	My		+	
Carex laxiflora	7						±			Fl	Ap	My			
Carex laxiflora latifolia	8							±		Fl	Ap	My			±
Carex lupulina	9					±				Fl	Je	Jl			
Carex monile	10									Fl	My	Je			
Carex oligocarpa	11							+	+	Fl	Ap	My			
Carex pennsylvanica	12							+		Fl	Ap	Je			
Carex riparia	13					+				Fl	Ap	My			
Carex Shortiana	14					+	+	+		Fl	Ap	My			+
Carex sparganioides	15					+				Fl	Ap	My			
Carex squarrosa	16					+				Fl	My	Je			
Carex straminea	17					+				Fl	Ap	My			
Carex tribuloides	18									Fl	My	Je			
Carex tribuloides cristata	19									Fl	My	Je			
Carex vulpinoidea	20					±				Fl	My	Je			
Cyperus acuminatus	21								Fl	Jl	Ag	×			
Cyperus aristatus	22									Fl	Jl	Ag			
Cyperus diandrus	23									Fl	Jl	Ag			
Cyperus erythrorhizos	24	±				±			Fl	My	S	±			
Cyperus esculentus	25	±							Fl	My	S				
Cyperus filiculmis	26								Fl	My	S				
Cyperus ovularis	27	±		±					Fl	My	S				
Cyperus Schweinitzii	28								Fl	Je	Ag				
Cyperus speciosus	29								Fl	Je	Ag				
Cyperus strigosus	30								Fl	Je	Ag				
Dulichium spathaceum	31								Fl	Jl	S	×			
Eleocharis acicularis	32								Fl	My	O	±			
Eleocharis compressa	33								Fl	My	Jl				
Eleocharis ovata	34								Fl	My	O				
Eleocharis tenuis	35					+			Fl	+	Ap	My			
Eriophorum lineatum	36					+			Fl	My	Je				
Fimbristylis autumnalis	37								Fl	Je	S				
Scirpus atrovirens	38								Fl	Ap	Jl				
Scirpus fluviatilis	39								Fl	Je	Jl				
Scirpus lacustris	40								Fl	Je	O				
Agropyrum repens	41								Fl	Je	Jl				
Agrostis alba	42	±		±	±	±			Fl	Je	Jl		±		
Agrostis scabra	43	+			+			+	+	Fl	Ap	My	+		+
Alopecurus geniculatus	44	+		+		+				Fl	Ap	My			
Andropogon furcatus	45								×	×	Fl	Ag	×	S	
Andropogon scoparius	46								+	+	Fl	Ag	×	S	
Aristida oligantha	47	×		+						Fl	Jl	S			
Asprella Hystrix	48							×		Fl	Je	Jl			×
Avena sativa	49	+	+		+					Fl	My				
Bouteloua racemosa	50									×	Fl	Jl	S		
Bromus secalinus	51	+		+	+					Fl	My	Je			

SOURI													ILLINOIS												
Bluff			Lowland						River				Lowland								Bluff		Upland			
15	16	17	5	18	19	11	12	12	20	21	22	23	26	25	14	11	12	12	11	18	24	16	15	14	12	7	6
												1		+	Fr	+	+	Je	+	Jl							
												2				Fr	+	Je	Jl								+
		+						+				3			+	+	+	Fr	+	Je	Jl						+
												4				+	Fr	Je	Jl								
												5				Fr	My	Je							+		
												6				Fr	My	Je								+	
	±											7			±	±	±		±	±		±					±
	±	±										8				Fr	Je	Jl				±		±		±	
			±									9		±	Fr	±	Ag	N	±								
			+					+				10		+	Fr	+	+	Jl	+	Ag							
												11				Fr	My	Je						+		+	
		+										12				Fr	Jl	Ag				+				+	
			+			+						13		+		+	Fr	My	+	Je							
		+	+			+						14				Fr	Je	Jl									+
			+			+						15		+		+	Jl	Ag	+								
			+			+						16		+		+	Jl	Ag	+								
			+			+						17		+		+	Je	Jl	+								
												18		+	Fr	+	Jl	Ag	+								
												19		+	Fr	+	Jl	Ag	+								
			±			±						20		±	Fr	±	Jl	Ag	±								
			×			×			×		21	×	×			×	Fr	S	×	O							
									22	×	=	×	×			Fr	S	O								
								23	×	×	=	×				Fr	S	O								
			±			±						24	±	±	Fr	±	Jl	O	±								±
												25			Fr	Jl	O	±									
												26			Fr	Jl	O	±									
							±					27			Fr	Jl	O	±									
										×	28	×			Fr	Ag	S	×									
										×	29	×			Fr	Ag	S	×									
										×	30	×			Fr	Ag	S	×									
						×						31			Fr	×	S	O	×								
						±						32			Fr	±	Jl	O	±								
												33	±		Fr	±	Jl	S	±								
			±			±						34	±		Fr	±	Jl	O	±								
			+					+				35				Fr	+	Je	Jl	+							
			+			+						36		+	Fr	+	+	Jl	+	Ag							
			×							×		×	37			Fr	×	S	N								
								±					38			Fr	±	My	S								
												39		±	Fr	±	Ag	S	±								
						±						40	±		Fr	±	±	Ag	±	O							
				±	±							41				Fr	Ag	S		±	±						
		-	±									42				Fr	±	Ag	S	±					±		
							+					43				Fr	My	+	Je					+	+	+	
						+		+				44				+	+	Fr	+	Je	Jl						.
												45			Fr	S	O	×							×	×	
												46			Fr	S	O	×							×	×	
					×						47	×			Fr	S	O	×							×	×	
	×	×		×								48				Fr	Ag	S				×		×		×	
				+								49				Fr	Je	Jl									
×												50				Fr	Ag	O					×		×		
				+	+							51			Fr	Jl	Ag	+								+	

Distribution and Phenology		Weeds					MIS- Upland								
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Cenchrus tribuloides	1									Fl	Je	Ag			
Dactylis glomerata	2	±	±	±	±					Fl	My	Ag			
Danthonia spicata	3								+	+	Fl	Ap	+	My	
Diplachne fascicularis	4									Fl	Jl	S			
Eatonia obtusata	5									Fl	Je	Jl	×		
Eatonia pennsylvanica	6							+		Fl	Ap	My			+
Eleusine indica	7	±	±	±						Fl	My	S			
Elymus canadensis	8									Fl	Je	Jl			
Elymus striatus	9	±			±		±			Fl	My	Je	±		
Elymus virginicus	10	±			±					Fl	Ap	My		±	
Eragrostis reptans	11									Fl	Ag	S			
Festuca tenella	12								+	Fl	Ap	My	+		
Glyceria nervata	13					+			Fl	Ap	My	+			
Hordeum jubatum	14			+						Fl	Ap	My			
Koeleria cristata	15									Fl	Ap	My			
Leersia oryzoides	16								Fl	Jl	Ag	×			
Leersia virginica	17									Fl	Jl	Ag			
Melica diffusa	18							|		Fl	Ap	My			|
Muhlenbergia diffusa	19							×		Fl	Jl	Ag			×
Muhlenbergia glomerata	20									Fl	Jl	Ag			×
Muhlenbergia sobolifera	21							×		Fl	Jl	Ag			×
Panicum Crus-galli	22					±				Fl	Jl	S			
Panicum depauperatum	23								+	+	Fl	Ap	My		
Panicum filiforme	24							±		Fl	My	Je			±
Panicum proliferum	25	±	±							Fl	Jl	Ag			
Panicum sanguinale	26	±	±	±	±					Fl	Jl	S			
Paspalum fluitans	27									Fl	Jl	Ag			
Phalaris canariensis	28									Fl	Jl				
Phleum pratense	29	±			±					Fl	Je	S	±		
Phragmites communis	30									Fl	Ag	S			
Poa annua	31	+	+	+	+					Fl	Ap	My			
Poa compressa	32	+	+	+	+					Fl	Ap	My	+		
Poa pratensis	33	+	+	+	+		+			Fl	Ap	My	+		
Setaria glauca	34	×								Fl	Jl	Ag			
Setaria italica	35	×								Fl	Jl	Ag			
Setaria viridis	36	×								Fl	Jl	Ag			
Sorghum Halepense	37									Fl	Je	Jl			
Spartina cynosuroides	38									Fl	Jl	Ag			
Sporobolus asper	39									Fl	Ag	S			
Sporobolus vaginaeflorus	40									Fl	Ag	S			
Triodia cuprea	41			×	×					Fl	Ag	S			
Uniola latifolia	42							×		Fl	Jl	S			×
Zea Mays	43	×	×							Fl	Je	Jl			
Equisetum arvense	44						+								
Equisetum laevigatum	45														
Equisetum robustum	46														
Adiantum pedatum	47						±				±				±
Aspidium acrostichoides	48										±				±
Aspidium marginale	49								±						
Asplenium angustifolium	50														
Asplenium ebeneum	51														

SOURI												ILLINOIS															
Bluff			Lowland						River					Lowland								Bluff		Upland			
15	16	17	5	18	19	11	12	12	20	21	22	23	26	25	14	11	12	12	11	18	24	16	15	14	12	7	6
				×							1	×			Fr	Ag	O	×			×						
				±								2				Fr	Jl	O		±							
+												3				Fr	Je	Jl					+		+	+	
											=	4		×		Fr	Ag	O									
												5				Fr	Ag	S								×	
	+											6				Fr	Je	Jl				+		+		+	
				×								7				Fr	Jl	S		×							
	±			±	±							8				Fr	Ag	O		±	±	±					
				±	±		±					9				Fr	Ag	±	S						±		
				±	±			±				10				Fr	±	Ag	S	±	±			±			
						×		×	×		×	11				×	Fr	S	×	O							
												12				Fr	My	+	Je					+		+	
						+						13		+		+	Fr	Jl	+	Ag							
								+				14				Fr	Je	+	Jl								
+												15				Fr	My	Je					+			+	
						×						16				×	Fr	Ag	S								
								×				17			×	Fr	Ag	S						×			
												18				Fr	My	Je									
	×											19				Fr	S	O						×			
	×											20				Fr	S	O						×			
×	×	×										21				Fr	S	O						×			
			±			±		±				22	±	±		±	±	Fr	±	Ag	O						
+												23				Fr	Je	Jl						+			
	±						±					24				Fr	Jl	±	Ag								
												25				Fr	±	S	O								
				±	±							26				Fr	Ag	±	N	±							
											=	27				×	Fr	S	×	O							
				×								28				Fr	Ag	S									
				±			±					29			Fr	Ag	±	±	O	±	±				±		
												30							±								
				+	+		+					31				Fr	My	+	Je	+	+						
				+	+							32				Fr	Jl	Ag		+	+						
				+	+		+					33				Fr	Je	Jl		+	+					+	+
				×								34				Fr	S	O		×							
				×								35				Fr	S	O		×							
				×								36				Fr	S	O		×							
					×							37				Fr	Ag	S		×							
						×		×	×			38		×	Fr	×	×	S	×	O							
×	×											39				Fr	S	O				×	×				
×	×										40	×				Fr	S	O				×	×				
				×	×							41				Fr	S	O		×	×						
	×	×										42				Fr	Ag	O				×		×			
												43				Fr	Jl	S									
				+	+							44			Fr	Ap	My	+								+	
											45	|			Fr	|	Je	Jl									
											=	46	±	±	Fr	±	Jl	Ag	±									
	±	±										47				Fr	Jl							±			±
		±										48				Fr	Je	Jl						±			
±												49				Fr	Jl	Ag					±				
												50				Fr	Jl	Ag						±			
	±	±										51				Fr	Jl	Ag				±					

Distribution and Phenology	Weeds					MIS-								
						Upland								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Asplenium thelypteroides. 1														
Cheilanthes lanuginosa. 2														
Comptosorus rhizophyllus. 3							*‡							
Cystopteris bulbifera. 4														
Cystopteris fragilis. 5						±				±				
Onoclea sensibilis. 6														
Pellaea atropurpurea. 7														
Phegopteris hexagonoptera. 8							±							±
Pteris aquilina. 9								±	±					±
Woodsia obtusa. 10														±
Botrychium virginianum. 11														+
Ophioglossum Engelmanni. 12									+					
Isoetes melanopoda. 13														
Azolla caroliniana. 14														

SUMMARY.

The area covered is too small to attach importance to a variation in climatic factors, i. e., seasonal means and extremes of temperature, the amount and distribution of rainfall, the humidity of the air and the movements of the atmosphere, factors which determine the type of the vegetation and the type of the flora,* as influencing the distribution of the different local species through the various regions which may be distinguished in the section studied. Where most conditions are fairly uniform, as for instance on the western plains or the plateaus of the Yellowstone, the presence of any plant, and modifications of its habit, its morphological, phenological and even minute physiological characters, may frequently be ascribed to modifications of a single factor. The physical condition, including color, of the soil, and the amount of water present and available, the presence or absence of a single element, variation in the amount of another, differences in the amount or nature of light, the direction and intensity of the prevailing winds, altitude and a number of other factors, yield instances too well known to require repetition here. But where conditions are diversified the agency of a single factor is no longer a

* Schimper, A. F. W. Pflanzengeographie. 174. 1898.

SOURI											ILLINOIS														
Bluff			Lowland						River				Lowland									Bluff		Upland			
15	16	17	5	18	19	11	12	12	20	21	22	23	26	25	14	11	12	12	11	18	24	16	15	14	12	7	6
												1				Fr	Jl	Ag						±			
±												2				Fr	Je	Ag					±				
*‡	*‡											3				Fr	Je	S				*‡	*‡	*‡			
												4				Fr	Jl	S					±				
	±	±										5				Fr	Jl	S					±				±
	±							±				6		±		Fr	±	Ag	S			±					
*‡												7				Fr	Jl	S					*‡				
	±	±										8				Fr	Jl	S				±		±		±	
												9												±			
±	±	±										10				Fr	Jl	S				±	±	±			
	+	+										11				Fr	My	Je	+			+					
												12				Fr	My	Je									
												13		×					×								
												14				×	Fr	Jl	Ag								

sufficient explanation. A large number of factors must be taken into consideration and under such conditions it frequently becomes a matter of personal bias or of greater knowledge in a chosen field whether to one factor or another the preponderating influence is ascribed. When Cowles, in his Physiographic Ecology of Chicago, presented a physiographic theory, he was able to combine the different factors in one great whole, since physiographic forces, in their widest sense, acting upon the surface of the globe, determine not only the physical and chemical nature of the soil and the topography, but by influencing the local distribution of plant life, also influence the amount and character of light received and the temperature. The term "physiographic forces in their widest sense" is used, for it is clear that while they acted upon geological formations, the very nature of the latter has governed the extent of their influence which was and is less far reaching where they act upon igneous rock than where lime or sandstones are concerned. Again, certain limestones are acted upon far more readily than are others, and the position of the strata is an important factor. But apart from similar initial conditions it would seem that physiography is and was the most important factor. This certainly is the case in the region under consideration. For in a measure it has determined the chemical nature of the

soil, being responsible for the absence of loess in certain portions of the territory (cliffs), for the presence of colluvial soil (at the base of slopes), for the presence of wide stretches of sand (in the bottomlands of the Mississippi), etc. It further governs the amount of soil water, being directly responsible for the xerophytic character of the upper portions of more recent ravines as contrasted with the mesophytic conditions prevailing in other portions. In thus influencing vegetation, physiography also modifies light and temperature, thereby inducing still other changes in the plant associations.

By ascribing to physiography in its widest sense the diversity shown by the flora in different regions, the issue has merely been postponed, for it remains to be decided which of the factors subordinate to physiography is of greatest influence. The question is one difficult to answer, for it would seem that now one factor, then another, is of greatest importance. Besides, plants possess an immense power of adaptation to their surroundings and are able to support a great variation in the degree of any one factor. This is best illustrated by greenhouse plants, originally growing under the most diverse conditions, which vegetate side by side in uniform surroundings and even flourish when sufficient space is given. But this is true for adult plants only. Seedlings are far more exacting, especially in regard to proper conditions of temperature and soil humidity. The chemical condition of the soil seems to be of the slightest importance. This statement applies to the majority of soils, for though their composition may vary greatly, it is but seldom that one or more substances are present which, because of their presence or the amount in which they are present, directly or indirectly either retard germination or so affect the seedling as to severely injure it or prohibit its very existence. The salty lands of sea-coast marshes and the alkali lands are exceptions to this rule. Comparatively few species can exist here. While cultivated plants with a few notable exceptions are affected by the salts of the alkali lands, there are a number of native species which flourish on them.* Alkali lands,

* Hilgard, E. Soils. 430.

however, being limited to regions with deficient rainfall, need not be considered here. But it is different where the quantity of lime in the soil is concerned. Though the loess is bedded on the limestone, the thickness of the former is often so great that the substratum is of no influence on the top soil. but most of the colluvial soil and the soil of the bottom lands comes under its influence. The analysis of the bluff soil, given in a former chapter, shows a very fair percentage of limestone,* though to attain the highest productiveness twice the amount would probably be necessary. Not only is the presence of lime in a soil beneficial, since, as before mentioned, it increases the amount of humus and causes the soil to assume a darker color, but according to the experiments of Liebenberg it is beneficial to germination. His results agree with those obtained by Claudel and Crochetelle,† whose experiments are discussed by Hicks,‡ who, in a resume of the work of the French investigators says:

"Alkaline substances with a basis of lime or of potash favored in a marked degree the germination of certain seeds, notably those of the Leguminosae. The slag used produced better effects than the lime alone.

"In the same paper the authors give the results of experiments conducted to obtain information concerning the acids set free or originating during the germination of seeds, which showed that the amounts of acids thus formed are sometimes very great; hence it is concluded that lime, slag, and liquid manure act by saturating these acids in proportion to the amounts formed. Also, that the loss of phosphoric acid, which is excreted in considerable amount in the germination of wheat, for instance, is hindered by these alkaline substances, and thus conserved for the use of the young plant. These conclusions, in the opinion of Claudel and Crochetelle, explain to a certain extent the beneficial effect of lime, slag, and ashes upon acid soils. Seeds of clover were found to produce more acid for a given weight than any other seeds

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* Hilgard, E. Soils. 497.

† Annales Agronomique. 131. 1896.

‡ Hicks, G. H. The germination of Seeds as affected by certain Chemical Fertilizers. U. S. D. A. Div. Bot. Bul. 24. 1900.

studied, thus explaining the fact that clover does not appear in acid soils prior to the addition of lime, ashes, or slag."

Hicks, in his own experiments, came to the conclusion that unless an excessive amount of lime is applied, this substance is helpful to germination. There remains, of course, the question of calciphile and calcifuge plants, but Hilgard,* again calls attention to the fact that while in certain regions a plant may be calciphile, in others it may be indifferent.

For these reasons it would seem that in the present instance we may safely ignore the question of the chemical condition of the soil, and that, in this region, under physiography, water is the most important factor in determining the nature of the vegetation. For though, to a certain extent dependent on the physical and chemical nature of the soil, in most cases it is of greater influence than either and also directly and indirectly modifies the temperature of both soil and air.

The correctness of this assumption seems to be borne out by the history of the country studied, which, briefly recapitulated, is as follows. It formed originally part of an extensive peneplain, which, in pre-glacial times, was divided into an eastern and western portion by the trough of the Mississippi. After the glacial period the land, at that time at a considerably lower level, was covered by extensive and slowly moving bodies of water which deposited a fine, almost impalpable sediment, the loess. As the result of a general uplifting, the loess was exposed and the Mississippi excavated its channel, the position of which has changed in the course of time, shifting towards the Missouri shore. It is not to be supposed that the land, at the time of the uplifting, presented a uniformly level surface. As the bottom of a lake shows areas of greater and less depth, so the plateau probably possessed a more or less uneven surface. Long, gentle slopes alternated with larger or smaller level stretches. This surface was further furrowed by the physiographic forces which continue to exert their influence to the present day. The water of precipitation cut miniature cañons in the loess. These, especially where abutting on the bluff, be-

* Soils. p. 521. See also Science n. s. **37**: 140. Ja. 24. 1907.

came wider and extended farther inland, forming ravines. The ravine, often assisted by the settling of the earth crust through the breaking down of the roofs of caverns, gradually became wider and acquired gentler slopes. This action continues till base level is reached.

It is probable that at first the entire upland was covered by innumerable shallow pools of varying extent, which in the course of time became so shallow that, at least during a portion of the year, they were dry or nearly so. The higher portions, situated at best a few feet above the water level, formed islands, soon occupied by grasses and sedges. These in a short time became associated with other phanerogams, chiefly annuals and biennials, such as *Artemisia, Xanthium* and *Oenothera* and which, if not the same species as those occurring to-day, were at least closely related. Willows, hackberries, coffee trees, birches and poplars followed, with here and there an ash. All of these, as the land became drier were replaced by elms, hickories and finally by oaks. Naturally the succession in the greater, submerged portion of the plateau did not take place as rapidly. The conditions existing at that time are, perhaps,to be compared with those we meet with to-day in the lowlands of the Mississippi. The typical lake flora, at first entirely limited to algae, later probably consisted chiefly of *Polygonum.* The edges were occupied by rushes and sedges. These, encroaching upon the water, and by their decay raising the level of the lake bottom, gave the willows an opportunity to gain a foothold. Or circumstances may have arisen by which an entire lake was suddenly drained. In that case there probably sprang up an extensive growth of *Forestiera.* Both willows and *Forestiera* in time came to be replaced by others till finally thc oak stage was reached. It is the stage reached at the present day and represents a condition which probably has existed for thousands of years. Yet evidence is not wanting that the oaks in their turn will be replaced by other trees such as sassafras and maple.

A succession like the one just described can be traced from the islands of the Mississippi to the different parts of the

American Bottom. All stages are represented at the mouth of the River des Pères in what is known as Horn's Grove (plates 18, 19). It shows that the nature of the soil has been an unimportant factor. Willows form the first woody vegetation on the sandbars, islands and shores of the Mississippi, as they do on the clayey bottoms or on the swampy uplands (plate 14, 1).

But have we a right to assume that the first beginning of plant growth in this region took place under the climatic conditions which prevail to-day? Perhaps the vegetation began with the retreat of the ice field. It is but reasonable to suppose, judging from conditions such as exist at the present day, for instance in Alaska, that the terminal moraine harbored at first a number of low growing arctic plants, followed by willows with a temporary climax of pine, hemlock and spruce. Evidence is lacking that any of the latter have occurred here, but the lack of such evidence is not conclusive. The conditions necessary for petrifaction were absent. Even had they existed, all remnants of an earlier flora would have been removed by the subsequent action of the waters as shown by their influence on the drift. The existence of a flora towards the end of the glacial period is of little interest in the present connection since there was no genetic continuity between it and the flora of to-day. Between the two lies the most recent period of submergence. Judging from the thickness of the loess, so long a time must have elapsed during its deposition, that when the ground became elevated, a climate must have existed not differing materially from that which prevails to-day.*

This tentative explanation of the forest growth, both in the bottom land and on the plateau, does not throw light upon the small patches of prairie which here and there occur in both regions. From early days the origin of prairies has been a source of speculation and many ingenious theories have been brought forward. Of special interest are the

* In connection with this see the interesting papers of Adams and others, references to which may be found in Adams, C. C. The post-glacial Dispersal of the North American Biota. Biol. Bull. **9**: 53. 1905.

papers of Gray*, Lesquereux† and Henry Engelmann.‡ The prairies of this region differ from those of the western United States, which find their origin in climatic conditions, in being due to local conditions, more particularly to the water relations. An examination of the limited prairies of the Missouri plateau shows them to have been swamp areas.

A study of the flora renders apparent the existence of three sharply defined physiographic regions, viz., the upland, the lowland and the river, in each of which an apparent equilibrium has been reached. Modifications of these regions, either the result of the influence of man or the action of natural forces, forms connecting links between them. Such are the swamps, the ravines, the sandbanks. In some, such as in the older ravines, changes in the apparent equilibrium are so slow as to be almost imperceptible. Here the sequence of events must be arrived at through analogy. In others, and this is true especially for the swampy regions, the changes may be exceedingly rapid, especially where man assists nature. Water content of the soil seems to play the most important part. Under the influence of man, the components of the original flora have undergone certain changes. Species have disappeared, others not only have taken their places but are attempting to take the place of others. The plants so active are mainly cosmopolitan. It is improbable that more than a small percentage of the original flora will disappear through their influence. The immigrants are limited chiefly to territory now under the influence of man. Under this influence the entire flora will not be destroyed, for in portions set aside for special purposes the original flora will persist at least until such a time as the entire region shall have reached base level.

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* Gray, A. Forest Geography and Archeology. Am. Journ. Sc. and Arts. 3 ser. **16 :** 85. 1878.—Géographie et Archéologie Forestières. Ann. Sc. nat. 6 sér. Bot. **7 :** 126. 1878.

† Lesquereux, L. On the Origin and Formation of the Prairies. Geol. Surv. 111. **1 :** 238. 1866.

‡ Engelmann, H. Remarks Upon the Causes Producing the Different Characters of Vegetation Known as Prairies, Flats and Barrens in Southern Illinois, with Special Reference to Observations made in Perry and Jackson Counties. Am. Jour. Sci. and Arts. 2 ser. **36 :** 384. 1863.

EXPLANATION OF PLATES.

Plate 10.—The Missouri shore at Selma, 42 miles south of St. Louis, showing the oak-covered plateau, the bare upper portion of the limestone cliffs and the vegetation-covered talus at the base, the railroad embankment and the shelving beach of the Mississippi.

Plate 11.—The Mississippi River at Selma, showing islands with their adjacent mudbanks. In the distance lie the wide and level stretches of the American Bottom.

Plate 12.—1, Upland pond near the edge of the bluff in the woods south of the buildings at Jefferson Barracks. 2, Projecting limestone ledge of the bluff south of Jefferson Barracks. The tree is *Fraxinus viridis.* Stems of *Tecoma radicans* run over the stone. Two plants of *Solidago Drummondii* and one of *Pellaea atropurpurea* have established themselves in crevices.

Plate 13.—Sinkhole vegetation, in this case consisting mainly of *Hydrastis canadensis,* which is in fruit. In the lower right hand corner can be seen leaves of *Arisaema triphyllum* and in the center a plant of *Arisaema Dracontium.* To the right of this are two plants of *Smilacina racemosa* and in the upper right hand corner two plants of *Podophyllum peltatum.*

Plate 14.—1, Upland swamp in the woods south of the buildings at Jefferson Barracks. The wide flat is covered with willows. Along the edges other plants appear, especially *Iris versicolor* and ferns. 2, *Convolvulus Sepium* twining among willows in the "bottoms" on the Missouri side of the Mississippi.

Plate 15.—1, "Bluff quarry" along the Mississippi river bluffs south of Jefferson Barracks, showing the projecting limestone ledges along the railroad track. On the left may be seen the thick covering of loess, deposited on the limestone during the Quaternary period. 2, Mouth of a creek south of Jefferson Barracks, showing the almost horizontal stratification of the St. Louis limestone at this point and the erosion due to the continued action of a comparatively small amount of water.

Plate 16.—Partially cut and burned vegetation on the railroad embankment near Jefferson Barracks, the growth consisting chiefly of *Rhus glabra.*

Plate 17.—*Polygonum Hartwrightii* in the wet bottoms of the Mississippi river near Jefferson Barracks.

Plate 18.—River des Pères and the adjoining bottoms east of the Broadway bridge. On the right is seen a dense growth of willows; in the center, clumps of *Forestiera acuminata.* In the distance, at the left, is a bank covered with oaks.

Plate 19.—Detail of the preceding plate. 1, Clump of *Forestiera acuminata;* at the left a single tree of *Gleditschia triacanthos.* 2, On the right, willows; on the left, *Ulmus americana;* plants of *Vernonia noveboracensis* and of *Forestiera acuminata* in the foreground.

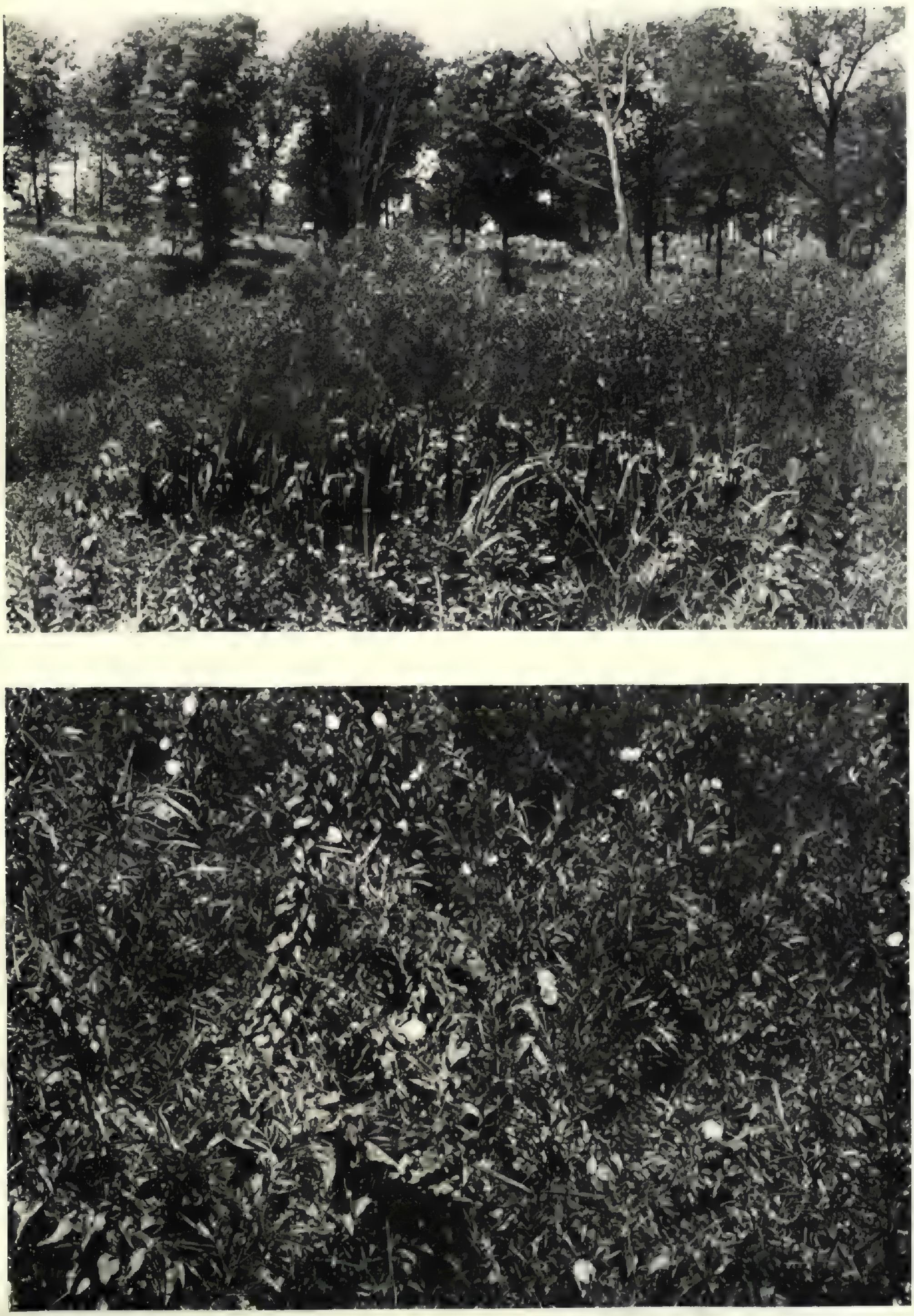
Plate 20.—*Nelumbium luteum* and *Polygonum Muhlenbergii* in Pittsburg Lake, St. Clair Co., Ill. The dead and dying trees are willows.

THE MISSOURI SHORE AT SELMA.

THE RIVER at SELMA.

UPLAND POND and BLUFF.

SINK-HOLE VEGETATION.



IRIS AND CONVOLVULUS.

OUTCROPS OF LIMESTONE.

RHUS ON RAILROAD EMBANKMENT.

RIVER DES PÈRES.

BOTTOM FLORA, RIVER DES PÈRES.

LAKE FLORA, ILLINOIS BOTTOMS.

ILLUSTRATED STUDIES IN THE GENUS OPUNTIA.—I.

BY DAVID GRIFFITHS.

This paper contains descriptions of species collected and studied by myself in the field during the past five years. The type locality of each has been visited not less than twice, many of the plants have been grown to maturity from cuttings, and seedlings are being cultivated. The type numbers refer to specimens mounted on sheets, but the plants are also in cultivation.

The studies are to be continued as plants reach maturity. It will doubtless be necessary to say more about some of these as they get older and present other diagnostic characters.

Opuntia Cardenche sp. nov.

An open branching tree, 1.5 to 2.5 meters high, with a dark scaly trunk 6 to 10 cm. in diameter; joints variable, laterals commonly easily separable and shorter (1 dm.) than the main or secondary axes, which may vary from 2 to 6 dm. in length, last year's joints commonly close to 2 cm. in diameter, tuberculate, with the large oval areole on the upper shorter slope of the long compressed tubercle, the upper tubercular slope being nearly perpendicular in young joints; areoles broadly ovate, 5 to 7 mm. in longest diameter, usually showing distinct subareolate areas, gray-black below and gray-brown above, the wool area developing for some years until the areole becomes subcircular, often 1 cm. in diameter, or often elongated transversely; spicules in a compact tuft in upper portion of areole, dirty gray or yellowish in situ but distinctly bright reddish brown when separated from plant; spines on last year's joints 1 to 4, mostly 4, and most numerous near middle of joint, bone-like, translucent, or slightly flesh colored, or even reddish tinged at very base, erect, spreading, with lower central one longest (2.5 cm.) and others slightly shorter, all with deep straw-colored medium loose sheaths; intermixed with spines but distinct from spicules are 4 to 6 very small unsheathed, inconspicuous, fugacious, gray-black bristles, 3 to 6 mm. long; flowers light purple, about 4 cm. in diameter; petals obovate to obcordate, cuspidate pointed, denticulate, and often slightly crenulate; sepals greenish (second row), short, abruptly cuspidate pointed; filaments purplish green, stout; style white at base and tinged with purple above; stigma yellowish white, about 6-parted; ovary obovate, deeply pitted at apex, 2.5 cm. long, with areoles subcircular, 2 to 3 mm. in diameter on upper short and almost vertical slope of tubercle, bearing a compact tuft of spicules, a few scattering bristles like those of the stem, and a few fugacious, delicate white or yellowish, partially sheathed

spines, with dilated reddish bases; fruit remaining attached for several years, at 12 months of age yellow, nearly smooth, slightly dished, flattened or even convex at apex, with prominent spicules, 3 to 3.5 cm. in diameter.

The species may be looked upon as standing between *O. Kleiniae* and *O. imbricata*. Our cultivated specimens three years old have stems three inches in diameter at base and stand over five feet high.

The description is compiled from one taken in the field when the species was discovered, and another made of the living cultivated progeny. The specific name, cardenche, is universally applied to this species but it is also applied to the much more common species *O. imbricata*.

The type is no. 9221 D. G., collected April 21, 1908, from specimens cultivated from cuttings secured near San Luis Potosi, Mexico, in March, 1905.—Plate 21.

Opuntia neoarbuscula sp. nov.

A low spreading, compactly branched, cylindrical stemmed plant, 8 to 10 dm. high and 10 to 15 dm. in diameter, proliferously and compactly branched, the branches falling off readily; joints tuberculate, 10 to 15 cm. long, and about 8 mm. in diameter (last year); leaves subulate pointed, 8 to 10 mm. long, circular in section and with tips brownish or reddish; roots often but apparently not uniformly bearing tuberous thickenings; areoles large, 3 mm. in diameter, and convex, projecting 1 to 2 mm. high, dull gray; spicules dirty yellow with bases a little darker and brighter in color, 1.5 mm. long, in a compact bunch from upper portion of areole; spines, on late growth of last year, 1 completely sheathed about 2.5 cm. long, with 1 to 3 more delicate, partly sheathed, lower recurved ones, on older wood of last year centrals are 4 to 10, completely sheathed, from a more prominent projecting areole, straw color to brownish red, usually faintly annular; flowers dull red with more or less of purplish tinge with petals obovate, irregularly and minutely dentate, and often irregularly cleft, and sepals ovate, truncate or triangular and abruptly pointed above, filaments greenish below and purplish above and anthers orange; pistil about 2.5 cm. long with style greenish white below and slightly tinged with purple above, and stigma yellowish white, 6 parted, small; ovary obovate-clavate, tuberculate, 2.5 cm. long, with comparatively large brownish gray areoles, and one partially sheathed, delicate, fugacious spine, 1 cm. long, and 2 to 4 scattering, delicate, unsheathed, fugacious bristles.

This differs from *O. arbuscula*, to which it is most closely related, by color of flowers (of minor importance), difference in habit and character of spines.

The description is a compilation of two—one made in the field where the species was first collected, and the other from living, mature, cultivated plants. The name is coined to designate a relationship to *O. arbuscula* Engelm.

The type is a specimen prepared from the cultivated plant and numbered 9219 D. G., April 22, 1908. The plant was originally collected in the foothills of the Santa Rita Mountains, Arizona.—Plate 23, upper figure; compare Plate 22.

Opuntia castillae sp. nov.

An erect, compactly branched plant, 18 to 30 dm. high, with a strong, scaly, black trunk 3 or 4 dm. in diameter; young growth deep dark green, turning slightly glaucous, then scaly brown, and finally black; joints broadly obovate, commonly 21 by 28 cm., thick; areoles elliptical to obovate, about 6 mm. in longest diameter, enlarging to subcircular on old joints or in vicinity of the articulation becoming transversely elongated, or linear, deep purplish brown when young but soon becoming black; leaves dark glossy green, circular in section, subulate, with reddish apex, ending in a white or gray, delicate, recurved apiculus; spicules yellow, seldom visible on the joints; spines white, translucent bonelike when young but soon turning to a mottled, dirty gray, 1 to 5 on last year's joints, more commonly 1 to 2, but central, unless alone, more erect than others, when two or more, one or more tightly recurved, more or less flattened or triangular-twisted, never annular but sometimes crooked-wavey, 15 to 22 mm. long, increasing in both length and numbers for several years; flowers yellow, tinged with red, 8 to 9 cm. in diameter; petals broadly obovate, rounded, retuse-notched at apex and minutely and irregularly toothed on margin, yellow with tinge of red on outside in lower portion of midrib; sepals thick (second row), dull greenish-red, triangular pointed above and wing-like toothed edges; filaments yellow above and greenish below; pistil 2.5 to 3 cm. long; style brilliant red; stigma light green with tinge of red in outer folds as well as in the throat, 8-to 12-parted; ovary broadly obovate or subglobose with subcircular areoles about 2 mm. in diameter and 5 mm. apart, deep dark brown with sometimes a tinge of purple, beset with dark brown spicules and a few dark brown short (6 mm.) delicate, straight or contorted fugacious hairlike spines, deeply pitted at apex; fruit large, yellowish, toothsome.

This is known only from cultivated specimens brought from Mexico. In general habit and appearance it resembles *O. streptacantha* about as closely as any, but it is much less spiny and the spines are not so stiff and rigid. The joints also are somewhat longer and the fruit is entirely different.

The description is drawn from the cultivated plant which

reached maturity in 3 years from single joint cuttings. The name applied to the species is used in Mexico and along our border in a very loose way. It is applied to many species, and has no reference, as one might suppose, to their origin. This is but one of several species called "Nopal de Castilla."

The type is no. 9213 D. G., prepared from a plant which has been cultivated to maturity from cuttings secured in Southern Texas. The plants from which cuttings were secured were developed from cuttings brought from Mexico about twelve years ago. The species has been found in cultivation in several situations in southern Texas.—Plate 24.

Opuntia fuliginosa sp. nov.

A tall, open branching tree, 4 or more meters high, and 4 or more dm. in diameter at base, with a black scaly trunk, very woody; joints subcircular to obovate, bright yellowish, glossy green, invariably turning to a dark, sooty hue with a fungous (?) growth, very variable in size, commonly about 1.5 by 2 dm., thin, scarcely tuberculate, yet not perfectly smooth; leaves subulate pointed, 8 to 12 mm. long; areoles elliptical to obovate, 4 or 5 mm. in longest diameter, light gray becoming tawny and finally black, 3 to 4 cm. apart; spicules yellow, very variable, often brownish, unequal in length, but commonly 8 to 10 mm.; spines 2 to 3 cm. long, translucent, bone-like, light brown, becoming whitened distally, leaving bases brownish translucent but in second or third year becoming a dirty, mottled gray throughout, suberect, spreading, with the lower recurved and the central longest, flattened, and often twisted, 2 to 8 in number but more commonly 2 to 4, increasing in both length and numbers for 2 or 3 years; flowers yellow streaked with red and always red when closed, small, 4 cm. across when open and about 2.5 cm. long; filaments light chocolate; stigma yellowish green, 6- to 9-parted; ovary subglobose to obovate, deeply pitted, thickly beset with subcircular areoles bearing a few spicules and a few delicate fugacious spines; fruit red, obovate to pyriform, with circular areoles, well filled with a large tuft of prominent yellow spicules surrounded by the blackened wool, pulp very deep red and rind thin.

The species is easily recognized by its blackened appearance in its native habitat, but this coloration is entirely lost when cultivated in this country. The spines and flowers and bright glossy appearance of the young growth in its native home, and of the entire plant under cultivation (three years old) in this country, are very characteristic. The species is very

variable in spine characters, some plants being nearly spineless, but usually the spicules are never absent.

The original description was drawn at Estansuela in western Jalisco, Mexico, from plants in bloom. This was subsequently compared with plants at Guadalajara, and still further amended by a second visit to the latter place during maturity of the fruit. A name indicating a sooty appearance is preferred for this species on account of its prevalence, although this condition is evidently not normal.

The type is no. 7715 D. G., collected near Guadalajara, Mexico, April, 1905.—Plate 25.

Opuntia Cochinera sp. nov.

A low, rather compactly branched, turgid species, 8 to 12 dm. high, with broadly obovate, thick, turgid joints commonly 20 by 28 cm., but sometimes 25 by 40 cm., dull green when young, glaucous waxy when mature, and turning to a scurfy brown with age; areoles 1.5 to 4 cm. apart, circular to obovate, 3 to 6 mm. by 3 to 5 mm. in young joints, but increasing to nearly one cm. in diameter in age, reddish brown when young, but turning to a dirty gray, slightly convex; spicules very rare on the joints, an occasional areole with a bunch of long yellow ones, 3 mm. long, with remainder of joint devoid of them; spines white becoming mottled gray with age, flattened and often twisted, erect-divergent, but often with a strong tendency to be recurved, 3 to 6 on this and last years' joints, but often 15 to 20 on older wood, about 2 cm. long on younger joints, and 3.5 to 4 cm. long on older wood; flowers yellow; fruit red, subglobose, 5 to 6 cm. in diameter, with thick, heavy rind, circular areoles 3 mm. in diameter and 8 to 12 mm. apart, bearing short, yellow spicules about 2 mm. long and a few longer, delicate fugacious spines; seeds large, strongly angular, with heavy, irregular marginal thickening.

This species has characters resembling those of very widely differing species. Outwardly the fruit resembles that of nopal arton, a large robust species closely related to *Opuntia streptacantha*. In form the joints resemble that species also, but in color and texture they resemble those of nopal tapon, *O. robusta*. The spines and spicules resemble those of tapon quite closely, except in numbers and size. On the herbarium sheet the joint looks like a short, stout, white spined form of tapon.

The description was drawn beside the plant in the field. The specific name is considered by the Mexicans to be de-

rived from the Spanish word for hog. It may be derived from cochineria, the equivalent of the English word meanness, referring to the spines.

The type is no. 8490 D. G., collected at Los Campos, Zacatecas, Mexico, September 5, 1906.—Plate 26.

Opuntia Chavena sp. nov.

An open branching, erect tree, 18 to 30 dm. high, sometimes quite strict but more often with a span of 12 to 18 dm., with distinct black, scaly trunk; joints rather bright yellowish green, and maintaining the same color for four years or more, broadly obovate, about 22 by 30 cm. being common size; areoles circular below to obovate above, about 6 mm. in longest diameter, but increasing in size with age, 2 to 3 cm. apart; wool tawny, plainly cellular-jointed, black on surface; spicules lemon yellow, very variable in length, at times scarcely reaching surface of joint and at other times 9 to 10 mm. long; spines white with translucent tips, soon becoming mottled and finally dirty gray or black, slightly angular, flattened, but not twisted, 5 to 7 or 8 on last year's joints, and increasing to 15 or more on older joints, but apparently not increasing after 4 or 5 years, longest on last year's joints, 12 to 14 mm. and graduating down to 2 or 3 mm., often 3 cm. long on older joints, stiff, rigid, erect, spreading and very difficult to handle; flowers yellow, filaments greenish, style red, stigma light bright green (only one belated bloom seen); fruit red with thick rind and deeper red pulp, its areoles subcircular to obovate, 8 to 12 mm. apart, with a tuft of formidable yellow spicules surrounded by gray ends of wool, also bearing a few delicate fugacious yellow spines about 12 mm. long; seeds angular, scarcely notched at hilum, with narrow marginal thickening.*

The species is most closely related to the *O. megacantha-lasiacantha* group, but these species differ in fruit characters and color of joints especially, and constitute a distinct group in themselves. They are well recognized and divided into three or four varieties even by the Mexican peon.

In this species I include three varieties recognized by the Mexicans, namely, "caidillo," "chaveño," and "cascaron." The first is distinguished mainly by its habit of dropping its fruit when ripe, it also has on an average rather smaller joints. Cascaron has joints somewhat larger and more nearly circular than chaveño. The first and last names are less frequently used than chaveño, it being commonly the only name applied to any form of the species.

* See Bull. 16, *pl. 6, f. 8*, B. P. I., U. S. Dept. Agric.

The description is a compilation of three sets of notes taken in the same locality at different times. The specific name is universally used in the region to designate this plant. I am doubtful about its meaning. The significance of the names applied to the varieties is more evident.

The type is no. 8136 D. G., collected near Aguas Calientes, Mexico, September, 1905.—Plate 23, lower figure.

Opuntia Guilanchi sp. nov.

Plant erect, bushy, open branching, 1.5 to 2 meters high, often forming small thickets but also growing in isolated individuals, having a distinct trunk 15 to 25 cm. in diameter; joints obovate, commonly 16 by 24 cm., or less, often about 14 by 20 cm., medium dark green, minutely pubescent, turning brown papery-scaly and finally black; areoles subcircular to obovate, small, 2 to 3 mm. in diameter but increasing on old trunks to about 5 mm., slightly elevated, 12 to 15 mm. apart; wool light tawny black on end; spicules very light yellow, usually less than 2 mm. long for a year or more, and completely surrounded by the blackened wool, making them subcentrally located, but later they develop in upper portion of areoles to 2 mm. or more in length; spines white, becoming mottled very early and finally dirty gray, erect spreading, 2 to 3 on sides of last year's joints to 4 or 5 on the edges where the lower ones are recurved, slightly flattened, often twisted, never annular, brittle, brash and small in diameter, varying from 5 to 13 mm. in length on sides of last year's joints to 2 cm. on edges, increasing in both length and numbers on old joints where they may be 3.5 cm. long with one or more in each areole broadly curved; flowers not seen; fruit pubescent, aromatic, variable in color, mostly yellow, but often orange red at base and yellowish distally, rind greenish yellow, outside of pulp orange red with interior much lighter, and easily separable from seed, its areoles small, subcircular, about 6 mm. apart and beset with formidable yellow spicules, subglobose, about 4 cm. in diameter, with shallow, broad umbilicus; seeds irregular, angular, not notched at hilum and with marginal thickening very narrow. about 4 mm. in diameter.

The species stands in some respects between the durasnillo (*O. leucotricha*) and the *O. megacantha-lasiacantha* groups of Mexican prickly pears. It differs from both in stature and habit, from the former in its spines especially, and from the latter in color of plant body but more especially in its fruits.

The description is compiled from field notes taken upon two visits to the type locality, supplemented by the dried

specimens. The specific name is the common Mexican name applied to this plant.

The type specimen is no. 8149 D. G., collected near Zacatecas, Mexico, September, 1905.

Opuntia Guerrana sp. nov.

A suberect or ascending, open branching plant, 9 to 12 dm. high and about the same in diameter; joints oblong obovate to subcircular, thick, heavy, glaucous, blue-green, 15–20 cm. by 20–25 cm.; areoles black, subcircular to obovate, about 5 mm. in longest diameter; wool tawny; spicules yellow, abundant, unequal, on sides and lower portion of edge in a compact crescentic tuft, 1 to 2 mm. long but around the apex of joint there may be an abundance of them lengthened to 1 or 2 cm.; spines white or light straw color and translucent at the base but turning a mottled dirty black with age, 1 to 6, mostly 2 to 4, flattened, often twisted, erect, divergent or some of lower in areole somewhat recurved; flower yellow, filaments greenish white, stigma green, fruit subglobose, greenish white, 4 to 5 cm. in diameter, with seed variable and much aborted, but mostly large, 4–5 by 5–6 mm., deeply notched, marginal thickening prominent, 1 mm. wide.

The species is related to *O. robusta*, but is smaller throughout, with very different fruit. It is known as Nopal tapon or Nopal tapon blanco in some sections. This shows its relations to the common "tapon" of the Highland region.

The description is compiled from a partial description made in the field, supplemented by further notes from the dried specimens. It is with pleasure that I dedicate this species to my friend, Señor Enrique L. Guerra, who first called my attention to the existence of such a species and to whom I am indebted for much information about Mexican species of Opuntia.

The type is no. 8475 D. G., collected near Dublan Hidalgo, Mexico, September, 1906.

Opuntia discata sp. nov.

Plant ascending-erect, rather compactly branched, 9 to 15 dm. high and about the same in diameter; joints broadly obovate to subcircular, commonly about 25 by 27 cm., dark green when young, but gray waxy green when mature; leaves about 1 cm. long, subulate pointed, slightly flattened; areoles large, prominent, circular to oval, tawny to brown when young and black in age, 6 to 10 mm. in diameter, much larger on edges of

joint than on sides, often distinctly subareolate and developing new wool and spicules from season to season; spicules yellow, unequal, scattered, increasing with age, 2 to 3 mm. long but often 1 cm. or more in length; spines white or dirty gray, with often a reddish tinge below or often pinkish throughout, one on lower portion of joint to 7 above, commonly 3 to 6, the longest 2.5 cm. long, erect-divergent or often the lower recurved especially on edges of joints, angular flattened, very stout and formidable but neither annular nor twisted; flowers lemon yellow with bases of petals a darker orange; filaments greenish-white, style white, and stigma dark green, 8-parted; fruit obovate to pyriform, deep, dark red throughout, 6 to 7 cm. in length.

The species differs from *O. cycloides* in character of spines. In this species they are much shorter and more erect.

Description drawn in the field. The specific name refers to the shape of the joints.

The type is no. 7790 D. G., collected in the foothills of the Santa Rita Mountains, Arizona, April, 1905.—Plate 27, upper figure.

Opuntia ferruginispina sp. nov.

Plant erect-ascending with open-branching habit, 7 to 12 dm. in height and same or greater in breadth; joints broadly obovate, about 20 by 23 cm. in last year's growth, deep blue-glaucous green; areoles about 3 to 3.5 cm. apart, obovate, 6 to 10 mm. in longest diameter, gray to black, enlarging with age; spicules bright reddish-brown, numerous, unequal, formidable, often 12 mm. long but usually much shorter; spines numerous and formidable, brown at base but becoming gradually yellowish distally, 1 to 4 on last year's joints, becoming more numerous with age, flattened, twisted, faintly annular, diverging in all directions or often the lower recurved, the longest sometimes 6.5 cm. long but commonly about 4 to 5 cm. long, both spines and spicules increasing in numbers with age and enlarging the areole; flowers orange-red, about 7.5 cm. in diameter when open; petals broadly obovate, rounded above, with edge irregularly and minutely toothed and often slightly crenulate and with midrib terminating in a minutely cuspidate point often having a tinge of purple in its lower portion; sepals (second row), triangular-winged, greenish; filaments yellow with faint tinge of purple; pistil 3 to 3.5 cm. long; style white with faint tinge of purple; stigma light green, about 8-parted; ovary obovate to pyriform-stipitate, 5 to 6 cm. long, with tawny areoles comparatively distant and bearing a small tuft of reddish brown spicules of irregular length; fruit purple throughout.

This species differs from *O. Lindheimeri*, with which it has been confused, in color of plant body, color and character of

the spines and spicules, as well as in the color of the flower (of minor importance). It appears to be most closely related to Berger's *O. Winteriana.*

The description was drawn from the living plant in bloom in the field. The specific name refers to the color of the base of the spines.

The type is no. 9207 D. G., collected near San Antonio, Texas, April 21, 1908.

Opuntia magenta sp. nov.

Plants ascending to erect, divaricately and loosely branched, 6 to 10 dm. high, often forming thickets on steep banks and hillsides; joints obovate, 9.5 by 13 cm. to 11.5 by 21 cm., more commonly the former, bright green when young but turning to slightly glaucous green; leaves about 1 cm. long, circular in section, subulate pointed; areoles 2 to 3 cm. apart, ovate, obovate or subcircular, increasing in size with age; spicules yellow, 2 to 3 mm. long, in a compact bunch in upper portion of areole, but increasing with age, and becoming unequal and scattered throughout the entire black areolar area; spines reddish brown at base and yellow distally, turning chalky or dirty black, often chalky throughout without any evidence of red at base, 1 to 5 or 6, usually 3 or 4, erect, divergent or lower recurved, the longest 2 to 2.5 cm. long, slightly angular, flattened and faintly annular when young but all traces of this are lost with age; flowers a light magenta; petals obovate, broadly obcordate and cuspidate at apex; style and filaments pink, and stigma large, yellowish green, 8-to 9-parted; ovary obovate to pyriform, about 3 by 5 cm.; fruit reddish purple.

The species is easily distinguishable in bloom by the color of its flowers and at other times by the prominent peculiar black areoles which differ very much from the *O. Lindheimeri* group with which it has been confused. It differs in joints as well as in habitat from *O. angustata* as figured by Engelmann.

The description is compiled from one made in the field, amended by subsequent notes at another season. The name refers to the color of the flower.

The type is no. 7876 D. G., collected near Redlands, California, May, 1905.

Opuntia macrocalyx sp. nov.

A profusely, divaricately branched, ascending or erect, spreading plant, 9 to 10 dm. high and about the same in diameter; joints long-obovate,

variable but commonly 9 by 22 cm. for last year's growth, gray green, pubescent, velvety to the touch; areoles subcircular, usually 2 to 3 mm. in diameter, very close to 1 cm. apart, slightly sunken; wool tawny, prominent, as long as spicules and occupying lower half of areole; spicules reddish brown, about 1 mm. long, occupying upper half of areole, easily separable and causing fully as much annoyance in handling as those of *O. microdasys*, in age often appearing dirty yellow in situ but distinctly reddish brown when removed; strictly spineless; flowers yellow, green outwardly, the leaves on ovary very long subulate and changing gradually into the sepals which are very long subulate, delicately pointed, loosely arranged or often half recurved at apex, giving to the bud a rather ragged appearance; fruit red but both pulp and rind greenish, long obovate to cylindrical, about 2 by 7 cm., with but few rather small seeds, about 3 mm. in diameter.

This species has hitherto been confused with *O. microdasys*, from which it differs in shape and color of joints, general aspect of plant and especially in the floral and fruit characters. This species should not be confused with the brown spiculed form of *O. microdasys*. Such a form exists commonly in the States of San Luis Potosi and Zacatecas, Mexico, but it differs in no other way from the more common yellow spiculed form ranging from the Rio Grande region southward.

The description is compiled from copious notes taken at San Antonio, Texas, and Riverside, California, at various times during the past five years. The name refers to the long loosely arranged sepals which grade on the one hand almost imperceptibly into the leaves on the upper part of the ovary and on the other nearly as gradually into the inner perianth segments.

The type is no. 8283 D. G., secured from the Albert S. White Park, Riverside, California, May, 1906. Its origin is not known but it is found commonly cultivated in collections of cacti in the Southwest.—Plate 28. upper figure: compare with the lower figure.

Opuntia lucens sp. nov.

A low prostrate species, usually about 3 or 4 dm. high; joints subcircular to obovate, variable in size, 1 by 1.5 dm. to often 2 dm. in longest diameter, bright, glossy, yellowish green; areoles large, prominent, black, variable, obovate, 4 to 10 mm. in longest diameter, 2 to 4 cm. apart; wool tawny, turning black at maturity; spicules yellow, prominent, unequal,

commonly 3 mm. long on sides but mostly about 1 cm. long on upper edges, in crescentic bunch in upper portion of areole or scattered throughout its area; spines very variable in length, the longest centrals 3 to 4 cm. graduating down to ½ cm. in length, 2 to 5 in number with 2 or 3 additional delicate bristles besides, white with translucent tips and turning abruptly bright reddish brownish at base, flattened, angular, twisted, often striate but never annular; flowers yellow; fruit purple, obovate, with reddish purple rind and darker pulp; seed flattened, angular, deeply notched and having a prominent marginal thickening, 4 or 5 mm. in diameter.

The species is related to the *O. Engelmanni* group but has different habitat as well as other minor differences. The old joints in this locality become scaly brown after the first year, but this is probably due to parasitism. Plants which I have grown to four years of age are bright yellowish green, exactly like the younger growth in the natural habitat of the plant. The only difference in the cultivated specimens is a greater turgidity. The species is commonly called "cuija" but it is a very different plant from the one to which this word has been applied as a subspecific name.

The description is a compilation of two sets of field descriptions made at different seasons in the same locality, supplemented by additional notes from herbarium specimens. The name refers to the character of the surface of the joints.

The type is no. 8034 D. G., collected near San Luis Potosi, Mexico, August, 1905.

Opuntia linguiformis sp. nov.

An erect, ascending, or half prostrate species, commonly too weak to stand erect, young growth light blue-glaucous green, older growth yellow and becoming scaly, scurfy brown with age; joints very variable, linear to narrowly ovate-oblong, often 1 by 8 dm., or again broadly ovate or even subcircular; leaves about 6 mm. long, circular in section, cuspidate pointed; areoles subcircular, 4 to 5 mm. in diameter, tawny to gray-black, upper half filled with dirty yellowish-brown, unequal spicules, about 6 mm. long; spines yellow, commonly slightly tinged with red at base, angular, flattened, annular, slightly twisted, 2 to 6 on last year's joints, mostly 3 or 4, one 2.5 to 4.5 cm. long, erect or sloping downward slightly, the others divergent around it and much shorter; flowers deep yellow or old gold, 7 to 8 cm. in diameter, petals obovate, obcordate, cuspidate at apex, and minutely toothed on edge, filaments white, slightly greenish below, style white, slightly tinged with green at base; stigma yellow, about 9-parted, ovary obovate to pyriform, 6 to 7 cm. long, with small,

subcircular areoles bearing brown spicules with yellow tips and small delicate fugacious, tightly recurved spines; fruit reddish purple; seeds small, about 3 mm. in diameter.

This species is cultivated commonly throughout the Southwest, but has been considered a variety of *O. Engelmanni* by botanists who have considered it at all. Its origin has until recently been unknown. It is evidently a native of southern Texas and a rather rare species. I have seen it in three localities near San Antonio and one farther south.

Description drawn from mature cultivated plants. The Spanish name lengua de vaca is descriptive and appropriate for this species. The "cow's tongue" cactus is the commonly used English equivalent.

The type is no. 8377 D. G., collected near San Antonio, Texas, Aug., 1906.—Plate 27, lower figure.

Opuntia fusicaulis sp. nov.

An erect, strict, open branching tree from 4 to 5 meters high, with a black, scaly trunk, 3 or 4 dm. in diameter; joints very long, fusiform, commonly about 4 dm. long by about 12 cm. wide, glaucous blue-green; areoles subcircular, small, 2.5 mm. in diameter, and 2.5 to 3.5 cm. apart, slightly sunken; spicules, when present at all, scarcely reaching the surface; wool tawny; spines entirely absent or there may be one delicate, white, fugacious one in an occasional areole; flowers *said* to be red; fruit greenish white.

This species might be confused with *O. elongata*, but it is spineless and the joints are fusiform and differ in color.

The description is compiled from notes taken at Aguas Calientes, supplemented by additional descriptions made of the cultivated plant which is now three years old, but has not yet bloomed. The specific name refers to the shape of the joints.

The type is no. 9312 D. G., prepared from a specimen cultivated from cuttings secured at Aguas Calientes, Mexico, in March, 1905. It is known only from cultivation.—Plate 23, upper figure, at left.

U. S. Department of Agriculture.

EXPLANATION OF PLATES.

Plate 21.—Above, *Opuntia Cardenche* at right (1), *O. leptocaulis* at left (5): one of the others may be *O. Kleiniae,* and the remaining two are undescribed species for which more data are needed. Below, *O. Cardenche,* cultivated specimens at beginning of the fourth year's growth from small cuttings.

Plate 22.—*Opuntia arbuscula;* introduced for comparison with Plate 23. Above, the species as it grows naturally upon desert mesas near Tucson, Ariz., in favorable situations. Below, a tree form as it grows in favorable situations in deep cañons in foothills of the mountains at an altitude of about 4,000 feet.

Plate 23.—Above, *Opuntia neoarbuscula* in the center, *O. fusicaulis* at the left. The former is in the beginning of the third years' growth from small cuttings; the habit in nature and under cultivation is the same. Below, at the right, *O. Chaveña:* a joint from a native specimen at Aguas Calientes, Mexico.

Plate 24.—*Opuntia castillae.* Above, a single plant, early in the fourth year's growth. Below, terminal joints.

Plate 25.—*Opuntia fuliginosa.* Above, a potted plant about three years old. Below (marked by the basket), a native plant. The potted plant, grown in a greenhouse at Washington, is no more like the parent plant, in color, spine, or shape of joint, than *O. fulgida* is like *O. arborescens.* In open ground in California, the growth is normal.

Plate 26.—*Opuntia Cochinera.* Above, a typical native plant. Below, a single joint and fruit.

Plate 27.—Above, *Opuntia discata:* joints two months and one year old. Below, *O. linguiformis:* a mature cultivated plant.

Plate 28.—Above, *Opuntia macrocalyx:* joints in bud. Below, *O. microdasys:* a cultivated plant, for comparison.

OPUNTIA CARDENCHE AND O. LEPTOCAULIS.

OPUNTIA ARBUSCULA.

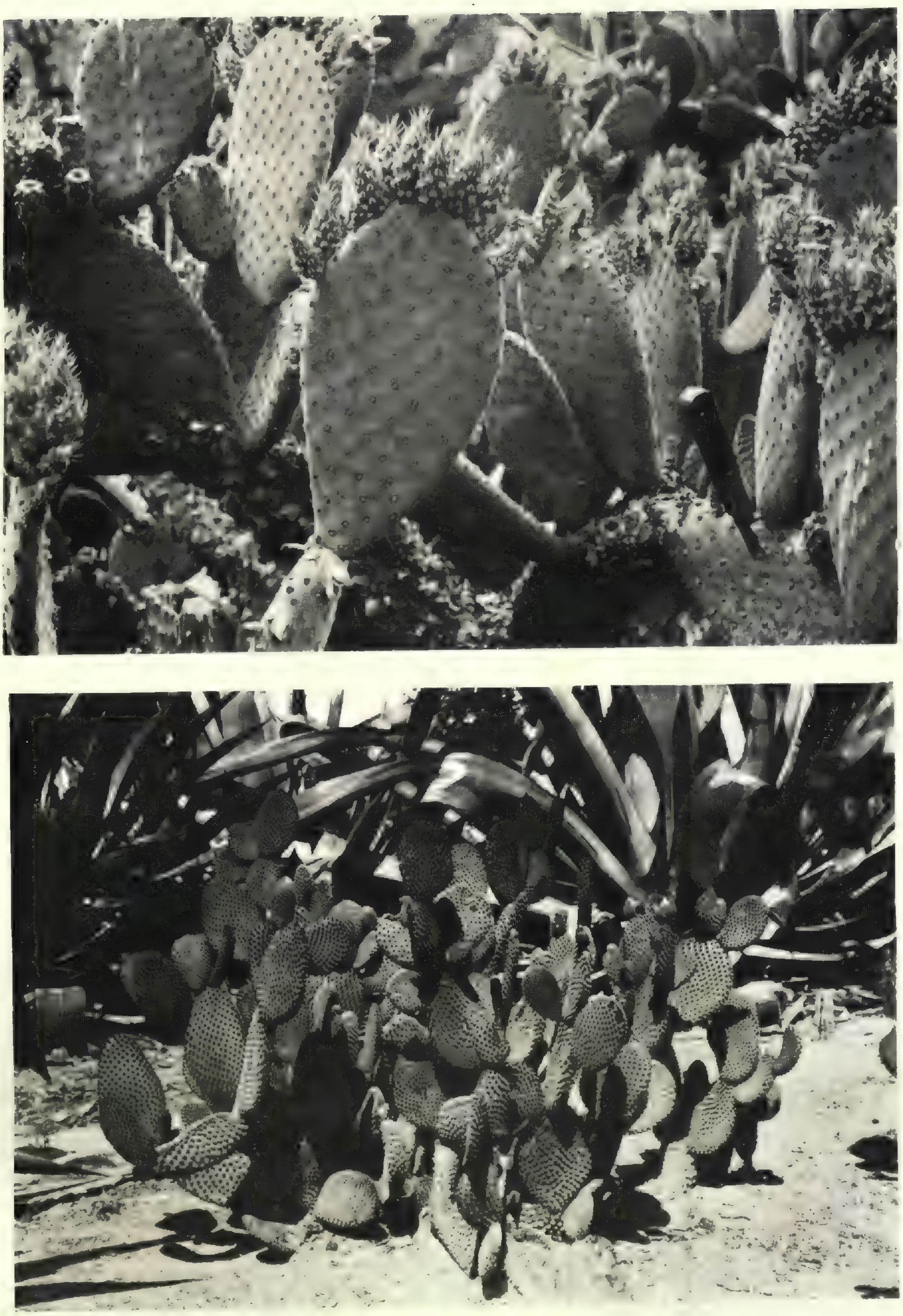
OPUNTIA FUSICAULIS, O. NEOARBUSCULA, O. CHAVEÑA.

OPUNTIA CASTILLAE.

OPUNTIA FULIGINOSA.

OPUNTIA COCHINERA.

OPUNTIA DISCATA AND O. LINGUIFORMIS.



OPUNTIA MACROCALYX AND O. MICRODASYS.

AGAVE RIGIDA—FURCRAEA RIGIDA
AGAVE ANGUSTIFOLIA.

BY WILLIAM TRELEASE.

These three names have stood as puzzles for nearly a century, though the first, with the others as synonyms, is now commonly applied to the Yucatan group of suckering henequen or sisal Agaves.

The original diagnoses are, respectively:—

"Foliis lineari-lanceolatis integerrimis rigidis aculeo terminatis."*
"Foliis lineari-lanceolatis superne integerrimis, basi ipso serrato-spinosis."†
"Caulescens, foliis anguste lanceolatis glaucis dentato-serratis."‡

Miller, calling it one of the tenderer sorts, says further of *A. rigida*, in the notes following his enumeration of species:

"The eighth sort hath long narrow stiff leaves, which are entire, and are terminated by a stiff black spine. These leaves are seldom more than two feet long, and little more than an inch broad, being of a glaucous colour; The side leaves stand almost horizontally, but the center leaves are folded over each other, and inclose the flower-bud. This sort never puts out suckers from the root, nor have I seen any plants of this kind in flower, although there are many of them in the English gardens, some of which are of a considerable age."

Haworth indicates that his *Furcraea rigida* is Miller's *Agave rigida* but not *Agave lurida* β of the then newly issued second edition of Aiton's Hortus Kewensis, though he saw it growing at Kew. He makes the observation on his *Agave angustifolia*, "folia angustissima omnium;" and a few years later§ writes:

"There are two plants of *Agave angustifolia* in Chelsea garden, lately brought back from the rock of St. Helena, by which we learn its native place. They were short-leaved on their arrival; but cultivation has already nearly communicated to them their customary appearance with us."

No other directly authentic publication on either is to be found, and no original herbarium specimens or living plants of either are known to exist.

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* Miller, Gard. Dict. 7 ed. *Agave* no. 8. (1759).—A binominal was first applied, under the same number, in the eighth edition (1768).

† Haworth, Synops. Plant. Succulent. 74. (1812).

‡ Haworth, *l. c.* 72.

§ Revis. Plant. Succulent. 35. (1821).

Agave rigida.

Agave rigida, said by Haworth to have been growing at Kew in 1812, and by Miller to have been abundantly represented in British gardens in 1759, is identified by the latter with the narrow-leaved Vera Cruz aloe of his earlier editions, in which it appears as no. 3, "Aloe, americana ex Vera Cruce, foliis angustioribus minus glaucis H. Beaum.," and as such is known to have existed in Great Britain at about the time when the first edition of his Dictionary was published (1731).* Haworth dates the cultivation of his *Agave angustifolia* [in England?] from before 1790, but without details.

Neither Miller's *rigida* nor Haworth's *angustifolia* can be brought into agreement with any of the few Agaves that had been noticed by Linnaeus in the first edition of his Species Plantarum (1753). The elder Aiton,† instead of adopting Miller's own binomial designation of it, called the broad-leaved Vera Cruz aloe *Agave lurida* *a* foliis latioribus, and under it placed what he took for Miller's *A. rigida* as *A. lurida* *β* foliis angustioribus,—without remarking that the latter differs from his diagnosis of the species: "subcaulescens, foliis dentato spinosis." Willdenow‡ made the same differentiation of broad and narrow forms, though he did not quote the Miller synonym of the latter. The younger Aiton§ con-

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* This information is derived from a copy of the sixth edition in the Sturtevant library at the Missouri Botanical Garden, which is inscribed as having been presented by the author in 1753 to James Justice (one of the subscribers whose names appear in the first edition), who marked this copy in ink so as to show the plants "cultivated by Mr. James Justice in his gardens at Creighton from anno 1726 to anno 1738."—It may be added that all but two of the American aloes of the sixth edition ("Aloe americana minor Munt." and "Aloe americana ex Vera Cruce, foliis latioribus & glaucis H. H.") are so marked.

That the narrow-leaved Vera Cruz aloe was also cultivated at Chelsea, at about this time, is indicated by Rand, who, except for the problematic "Aloe americana folio viridi serrato" and the broader-leaved Vera Cruz aloe, lists all of the American forms of Miller and Justice and adds the "Aloe americana, tuberosa, minor, spinosa, Par. Bat. Prod." [*Furcraea tuberosa*], which Miller took up twenty years later, when his "Aloe americana folio viridi serrato" was dropped from the Dictionary. (Rand, Hort. Med. Chels. Index. 11.—1739).

† Hort. Kew. **1**: 472. (1789). ‡ Sp. Plant. **2**: 194. (1799).

§ Hort. Kew. 2 ed. **2**: 302. (1811).

tinued to recognize the two forms of *lurida*, with *A. rigida* as a synonym of the second, though he omitted his predecessors' explicit reference to the toothed leaf margin of the species.

It is this *A. lurida β* of the younger Aiton which Haworth says is not his own *Furcraea rigida** or the equivalent *A. rigida* of Miller. As he accounts for all of Aiton's other forms of *Agave* and *Furcroea*, except *A. americana β*, which he says is not *A. Karatto* Miller, though he does not place it elsewhere, it must remain a question why he did not indicate the relations of the *lurida β* with his own comparable *Agave angustifolia*.

Miller did not give diagnoses in the earlier editions of his Dictionary, and there seems no way of learning the characters of his species except by their collocation and by reference to works in which others had described plants under the same polynominals,—in connection with his own diagnoses first introduced into the seventh edition. Joannes Commelinus,† who must be conceded to have known the plants of the Beaumont garden, on which rested the Kiggelarius polynominals taken up by Miller, had pictured the narrow-leaved less glaucous Vera Cruz aloe which Miller took as the prototype of his *Agave rigida*, a generation before the latter wrote. His plate, here reproduced on a reduced scale, shows some leaves quite entire, others armed nearly throughout, and still others toothed from the base to or about the middle. The somewhat glaucous lanceolate leaves were 2 × 18-24 in. (5 × 45-60 cm.), acutely channeled or valleculate toward the end, and, except for the abrupt strong black somewhat curved apical spine at least 2 × 10 mm., might pass rather for those of a *Furcraea* of the *Demouliniana* series than for those of an *Agave*.

Such a plant, not fully described in either diagnosis, and broader-leaved, but comprising the original marginal char-

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* After quoting the Miller diagnosis, differing from his own in reading "foliis . . . integerrimis," he says "nec *Agave lurida β* Hort. kew. ed. 2. v. 2. p. 302: sed in horto Kewense pulchrè crescit,"—the "sed" being ameliorated into "et," by manuscript correction, in a copy of the book presented by him to Treviranus, and now in the Engelmann library at the Missouri Botanical Garden.

† Hort. Med. Amstelodam. Rar. . . Plant. . . Descr. et Icon. **2 :** 33. *pl. 17.* (1701).

acters assigned by Miller to *Agave rigida* and by Haworth to what he considered its equivalent, *Furcraea rigida*, must have existed in cultivation through the eighteenth century, but seems hardly to have been seen since Haworth's time. What Salm* grew in 1859, and somewhat ambiguously described under Miller's name, he did not see how to separate from the description of Haworth's *angustifolia*,† which he did not knowingly grow, while Jacobi,‡ who saw Salm's specimen, clearly did not mean Miller's plant by his own *rigida*. Koch found only *angustifolia*, as (apparently rightly) he understood it, grown under this name in 1860;§ and in 1865 abandoned *rigida* altogether,¶ finding the name then used for a number of nominal species, all apparently comparable with the Indian *A. Cantala* and its possible segregates. No *Agave* at all well corresponding to Commelin's narrow-leaved Vera Cruz aloe, Miller's *Agave rigida*, or Haworth's *Furcraea rigida* seems to have been rediscovered since its importation by the Dutch; but a search for it in the field seems wiser than either the abandonment of the name or its merging under any known species as now characterized, and it is rather to be sought between Venezuela and Yucatan than to the north of the peninsula. Its synonymy is as follows:

AGAVE RIGIDA Miller, Dict. 8 ed. no. 8 (1768); Abr. Dict. no. 8. (1771); Dict. Jard. **1**: 57, 61. (1785).—Onomatologia **1**: 203. (1772).—Mawe, Dict. Gard. no. 4. (1778).—Dietrich, Vollst. Lex. **1**: 163. (1802).—Link, Enum. Berol. **1**: 334. (1821).—Steudel, Nomencl. 18. (1821).—Dietrich, Syn. Pl. **2**: 1192. (1840),—except for De Spin citation.—Koch, Wochenschr. Ver. Beförd. Gartenbau. **1860**: 48; **1865**: 101; Fl. des Jard. **1861**: 147; Belg. Hort. **1862**: 309.—Drummond & Prain, Agric. Ledger. **1906**: 143.

A. lurida β *A. rigida* Martyn, Miller's Dict. no. 4 β. (1807).

A. lurida second variety. Rees, Cyclop. **1**. no. 4. (1819).

A. Ixtli rigida Baker, Gard. Chron. n. s. **8**: 397. (1877).—Ricasoli, Bull. Soc. Tosc. Ort. **3**: 241. (1878).—Terracciano, Primo Contr. 44. (1885).

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* Bonplandia. **7**: 90. † *l. c.* 87, 95. ‡ Versuch. 94.

§ Wochenschr. Verein Beförd. Gartenbau. **3**: 48. ¶ *l. c.* **8**: 101.

A. foliis lineari-lanceolatis integerrimis rigidis aculeo terminatis. Miller, Dict. 7 ed. no. 8. (1759).

A. foliis dentato-spinosis . . . γ. Fabricius, Enum. Helmstad. 2 ed. 13. (1763).

Aloe americana ex Vera Cruce foliis angustioribus minus glaucis. Kiggelarius, Pl. Exotic. Hort. Beaum. Cat. (1690).—Commelinus, Hort. Med. Amstelod. Rar. . . Plant. . . Descr. et Icon. **2 :** 33-4. *pl. 17.* (1701).—Miller, Dict. no. 3. (1731, 1741, 1752).

Furcraea rigida Haworth, Syn. Plant. Succul. 74. (1812); 79. (1819).—Kunth, Enum. **5 :** 843. (1850).

Fourcroya rigida Schultes, Syn. **7**[1] **:** 731. (1829).—Steudel, Nomencl. 2 ed. 37. (1841).—Roemer, Ensatae. 292, 294. (1847).—Salisbury, Gen. Pl. 78. (1866).

Furcroea rigida Don, Sweet's Hort. Brit. 3 ed. 705. (1839).

The principal other uses of the name *Agave rigida* are as follows:

A. RIGIDA De Spin, Le Jardin de St. Sebastien. 23. *pl. 1.* (1812).

A. angustifolia (under which species other users of the name in this sense are enumerated).

A. RIGIDA Engelmann, Trans. Acad. St. Louis, **3 :** 316-319. (1875); Bot. Works. 312.—Hayn, Gartenflora. **43 :** 512. (1894).—Braun, Der Pflanzer. **2 :** 226. (1906).

A. Ixtli Salm as represented by the wild "chelem" of Yucatan, but with inclusion of *A. rigida* Miller and *A. angustifolia* Haworth and questioned addition of *A. Karwinskii* Zucc., and with the segregated varieties *longifolia* (*A. fourcroydes* Lemaire) and *sisalana* (*A. sisalana* Perrine). *A. decipiens* Baker and *A. neglecta* Small, of Florida, were also undifferentiated.

A. RIGIDA Hemsley, Biol. Centr.-Amer. **3 :** 348. (1882-6).—Weber in Bois, Dict. **1 :** 52. (1896).—Rivière, Journ. Agr. Trop. **1903 :** 5; Bull. Soc. Accl. Fr. Nov. **1907 :** 391-2.—Löfgren, Notas sobre as plantas . . . S. Paulo. 21. (1906).

A. rigida Engelmann with addition of *A. ixtlioides* Hooker (? *A. angustifolia* Haw.) and *A. elongata* Jacobi, and incorporation of the henequen varieties.

A. RIGIDA M[orris], Kew Bull. **1887.** March. 2, 3; Add. ser. **2 :** 131.—Gartenflora. **1887 :** 587.

A. rigida Miller (except for belief that this is the wild "chelem"), with segregated varieties *Ixtli* (*A. Ixtli* Salm), *elongata* (*A. fourcroydes* Lemaire) and *sisalana* (*A. sisalana* Perrine).

A. RIGIDA Baker, Handbook Amaryll. 181. (1888).—Gürke, Notizbl. K. Bot. Gart. Berlin. **1 :** 135. (1896).—Rose, Contr. U. S. Natl. Herb. **5 :** 239; Bailey's Cyclop. **1 :** 34. (1900).—Segura, El Maguey. 4 ed. 94.

(1901). — Ascherson & Graebner, Synops. Mitteleurop. Fl. **3 :** 416. (1906).—Boyd, Fibre Industry in Queensland. 6. (1906).

A. rigida Engelmann, with further inclusion of *A. ixtlioides* Hooker (? *A. angustifolia* Haw.), and with the segregated varieties *elongata* (*A. rigida longifolia* Engelmann + *A. elongata* Jacobi + *A. Candelabrum* Todaro) and *sisalana* (*A. rigida sisalana* Engelmann).—Thus essentially *A. rigida* Hemsley with these varieties segregated.

A. RIGIDA Saunders, Cat. Econom. Pl. U. S. Dep. Agr. 5. (1891).—Nash, Journ. N. Y. Bot. Gard. **8 :** 171. (1907).

A. sisalana Perrine.

A. RIGIDA Donn.-Smith, Enum. Plant. Guatemal. **2 :** 75. (1891).

One of the Tequilanae, as yet undescribed, cultivated in hedgerows on the Pacific slope of Guatemala.

A. RIGIDA Coulter, Contr. U. S. Nat. Herb. **2 :** 430. (1892).—Trabut, Rev. Hort. Algér. **5 :** 127, 132. (1901).—De Joinville, Atlas. 73. *f.* (1902).

Apparently *A. fourcroydes* Lemaire. The Coulter reference seems to rest on henequen plants escaping from trial plantations along the lower Rio Grande.

AGAVE RIGIDA Kew Bull. **1892 :** 21, 273; Add. ser. **2 :** 151.—Boeken, Tropenpflanzer. **4 :** 6. (1900).

Essentially the henequen and sisal varieties, segregated by Engelmann.

A. RIGIDA Baker, Kew Bull. **1892 :** 4, 35-6; Add. ser. **2 :** 220.

A. rigida Baker, Handbook, with further inclusion of *A. Cantala.*

A. RIGIDA Kew Hand List Tend. Monocot. 119. (1897).—Conter, Bull. Hawaii Exper. Sta. 4: 8. (1903).

Apparently *A. Ixtli* Salm.

A. RIGIDA Lebl, Gart. Mag. **50 :** 16. (1897).

A synonym of *Bonapartea rigida,* which name pertains to a form of *A. striata.*

A. RIGIDA Berger, Gartenwelt. **2 :** 578, 604. *f.* (1898).

A rough-leaved undescribed species of the Tequilanae.

A. RIGIDA Nicholson, Dict. Suppl. **1 :** 28.

A. Ixtli as to foliage. *A. ixtlioides* Hooker (? *A. angustifolia* Haw.) as to flowers.

A. RIGIDA Northrop, Mem. Torr. Bot. Cl. **12 :** 28, 78, 94. (1902).—Coker, Veg. Bahama Isl. 251. *pl. 40.* (1905).

The, as yet unnamed, "bamboo" of the Bahamas.

A. RIGIDA var. Hart, Rept. Trinidad Gard. **1890.**

A. angustifolia Haworth.

A. RIGIDA form. Baker, Kew Bull. **1892 :** 4; Add. ser. **2 :** 221. (1901).

A reference of *A. Cantala* and *A. Rumphii* of the Riviera gardens,—perhaps *A. Candelabrum* Todaro.

A. RIGIDA, form. Dewey, Rept. Dept. Agr. **1905 :** 145.—Braun, Pflanzer. **2 :** 210. (1906).

A passing reference of the, as yet unnamed, Zapupe or Tamaulipas henequen.

A. RIGIDA var. Merrill, [Publ.] Bur. Govt. Lab. Manila. **1 :** 85. (1905).

The *Agave americana* of Blanco, which is *A. Cantala* Roxburgh.

A. RIGIDA ANGUSTIFOLIA Kew Hand List. 119. (1897).

A. angustifolia Haworth.

A. RIGIDA ELONGATA, Baker, Handb. Amaryll. 181. (1888).

A. rigida longifolia Engelmann, with inclusion of *A. elongata* Jacobi and *A. Candelabrum* Todaro.—Most users of the name, however, mean the first only.

A. RIGIDA ELONGATA Bull. Grenada Gard. 30 : 285. (1893).

A. angustifolia Haworth.

A. RIGIDA ELONGATA Rose, Contr. U. S. Natl. Herb. **5 :** 247. (1899).

A. tequilana Weber?—From Lower California.

A. RIGIDA IXTLI Morris, Kew Bull. Mar. **1887 :** 2, 3.

A. Ixtli Salm.

A. RIGIDA LONGIFOLIA Engelmann, Trans. Acad. St. Louis. **3 :** 316. (1875).

A. fourcroydes Lemaire.

A. RIGIDA RECURVATA Mulford, Rept. Mo. Bot. Gard. **7 :** 96. (1896).

A. neglecta Small.

A. RIGIDA SISALANA Engelmann, Trans. Acad. St. Louis. **3 :** 312. (1875).

A. sisalana Perrine.

AGAVE ANGUSTIFOLIA.

Haworth clearly meant to apply the name *Agave angustifolia* to a plant differing in its more complete toothing from his *Furcraea rigida*, but there is no inherent indication that he meant it to be different from *Agave lurida β* of the younger Aiton, which, alone, of the forms of the latter, is unplaced, though definitely excluded from *F. rigida*. Though the name *angustifolia* has passed into disuse, there is less difficulty in connecting it with plants that have been described or figured during the past century, than in the case of the name *rigida*.

In 1790, Jacquin* had described and figured flowers, capsule, seeds and bulbil of a caulescent paniculate *Agave* received from the Dutch gardens in 1753, applying to it Aiton's

* Obs. Bot. **4 :** 94. *pl. 1.*

name *A. lurida*, but unfortunately giving no indication as to whether he meant the broad- or narrow-leaved form of that composite species; and Willdenow and the younger Aiton have complicated *lurida* by citing Jacquin's illustration as pertaining to it. The short urceolately beaked capsule and bulbil are indicative of something very different from the *Agave Vera Cruz* of Miller (*A. lurida* **a** Aiton) as now understood and excellently figured subsequently by Zuccarini;* and although the flowers are not characteristically pictured, Jacquin's herbarium, now at the Vienna Hofmuseum, contains flowers of "*Agave lurida* Hort. Schönbr.," which I was permitted by Dr. Zahlbruckner to photograph in 1905, that clearly belong with the short capsules and differ greatly from those of the broad-leaved *lurida* as understood by Zuccarini.

What was held for the *lurida* of Jacquin (but also referred back to the Commelin narrow-leaved Vera Cruz aloe) flowered at Florence in 1799 and again in 1909, when it was adequately described and figured by Targioni Tozzetti,† also under the name *A. lurida*, under which it occurred in Italian gardens at least as late as 1868, when Engelmann gathered representative material in the Botanical Garden at Naples.‡

The prickly *Agave rigida* studied by De Spin§ at San Sebastien, near Turin, in 1812, on which rests much subsequent characterization of the *Agave* so-called, was clearly Aiton's *A. lurida* β, and not the *rigida* which Haworth differentiated from it at about that time.

The unfortunate omission of a varietal designation for what the writers must have recognized as not its typical or "**a**" form, is responsible for much of the subsequent confusion attending the name *lurida*. That Jacquin's *Agave lurida* was not the typical *A. lurida* **a** of Aiton was recognized as early as 1813 at Kew by Gawler,¶ who, however, pictured what seems

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* Act. Acad. Caes. Leop. Carol. Nat. Cur. **16²:** 669-673. *pl. 49-51.* (1833).

† Ann. Mus. Imp. Firenze. **2²:** 25, 31-5. *pl. 6.* (1810).

‡ It was apparently withered flowers and fruit of such a plant, from Bellagio, on which Jacobi based his otherwise unknown *Agave flavovirens* (Versuch. 258), subsequently referred to by him as *flavoviridis* (Nachtrag. 2 : 75).—See Rept. Mo. Bot. Gard. **18:** 236.

§ Jard. de St. Sebastien. 23. *pl. 1.*

¶ Bot. Mag. **37.** under *pl. 1522.*

to have been the Dillenian "Aloe barbadensis mitior" for the latter, on an identification ascribed to the younger Aiton,—he himself not having seen the plant while in bloom, or any part of the specimen from which the drawing was made. Gawler is sometimes given as the authority for the name *A. Jacquiniana*, to designate this narrow-leaved *A. lurida* β; but in fact the name *Jacquiniana* was first published for it by Schultes,* in 1829, and then in a qualified way "si a reliquis diversa" so that the author of *A. Jacquiniana* is sometimes held to be Hooker,† who in 1859 applied the name to a plant which had then flowered at Kew, and was described and figured, though unfortunately the apical spine of the leaf is not well shown. The plant on which Hooker's description and illustration were based had been sent by Mrs. General MacDonald from Honduras, a dozen years earlier, in company with *Cereus Macdonaldiae*,—which in a way indicates its native home unless her plants were secured from a garden,—and Mr. Drummond writes me that derivatives of it are not known to exist.

Salm, whose *Agave rigida* is somewhat conformed in leaf-description to the *Furcraea rigida* of Haworth, but who evidently meant under this name the *rigida* of De Spin, and was unable to separate from it Haworth's *angustifolia*, tried to locate *Jacquiniana* in alliance with *lurida*, though he evidently did not feel sure that he really possessed it in his collection. By a slip, he changes the name to *Jacquinii*, under which, when it flowered again at Kew in 1873,‡ sucker-inflorescences were reported.§ Of late years, following this restoration of it to its original unfortunate place, it has been mentioned under the name *A. lurida Jacquiniana*, a number of times, but without material addition to what was before known of it. Here is apparently also to be referred *A. excelsa* of Baker (originally described¶ from Kew Material from Honduras, not improbably representing the lost *Jacquiniana* of the Botanical Magazine account), Ricasoli and Terracciano, which scarcely agrees with the description of Jacobi, who, however, recognized his *excelsa* in the *Jacquiniana* growing

* Syst. **7**[1]**:** 727. † Bot. Mag. iii. **15.** *pl. 5097.* ‡ Garden. **3 :** 390.
§ Gard. Chron. n. s. **3 :** 662. ¶ Gard. Chron. n. s. **8 :** 397. (1877).

at Kew; and *A. ixtlioides* Hooker is rather a low plant of this than the true *ixtlioides* of Lemaire or the *fourcroydes* of Lemaire or Jacobi, though the end-spine, if so, is very uncharacteristically drawn.

An obviously very similar plant has long been cultivated and escaping in India, where Wight* figured it with the erroneous name *A. vivipera* or *vivipara*, under which it has been cultivated or mentioned in print (often confounded with Baker's *vivipara*,—*A. Cantala*). This *Agave vivipara* of Wight, designated *Wightii* by Col. Prain† a few years since, has been described recently under the latter name by Drummond and Prain,‡ who do not overlook its possible identity with *A. Jacquiniana*.§

In 1890 an Agave was reported by Hart¶ for the West Indian islands St. Vincent and Barbados, as a very distinct variety of *A. rigida* (in the sense of Engelmann and Baker, therefore supposedly one of the henequen or ixtle forms); and the name *A. rigida elongata* has also been applied** to the same plant. Specimens of this form, at Kew, have been recognized by Mr. Drummond as being *A. Wightii*, which is therefore believed by him†† to be a native of the Antilles, though my own observation of it in Barbados scarcely warrants the conclusion that it is more than a hedge-row introduction. It is doubtful if it can be considered to be indigenous near the city of Vera Cruz.‡‡

Analysis of what is known of *Agave lurida* β Ait., *A. angustifolia* Haw., *A. Jacquiniana* Schult.,§§ *A. lurida Jacquiniana* Bak., and *A. Wightii* Dr. and Prain, or their sev-

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* Icon. Plant. Ind. Or. **6:** 18. *pl. 2024.*

† Proc. Agr.-Hort. Soc. Madras. **1904:** 130, 137; **1905:** 38.

‡ Agric. Ledger. **1906:** 78, *91*, 102, 105, 128, 139, 147.

§ *L.c.* 140.

¶ Rept. Trinidad Garden. **1890,** *fide* Gard. Mag. **35:** 160, etc.

** Bull. Bot. Gard. Grenada. 30 : 285. (1893).

†† Rept. Mo. Bot. Gard. **18:** 27. (1907).

‡‡ *Cf.* Drummond & Prain, Agric. Ledger. **1906:** 123.

§§ But not a plant so-called by Weisse (*e. g.*, Gartenflora. **20:**249.—1871) and others which, though of the fetid-flowered Sisalanae group, is a very large-leaved distinct species which as yet is known only in or about gardens.

eral synonyms, does not lead to the conclusion that these names pertain to more than one species—at least in the conservative use of this word—though differences exist in stem-height, degree of suckering, form of capsule, etc. Aiton not having named it, this species is entitled to *A. angustifolia* as its earliest name.

An interesting confirmation of this conclusion may be added. In 1816, Major General Beatson,* formerly Governor of St. Helena, published a list of the exotic and indigenous plants of the island, which he had received from Roxburgh only a few days before the death of this distinguished botanist, who, as well as Burchell, is known to have been there.† In this list (p. 296), *Agave lurida* "Linn." appears as the name of an exotic species used for fences. It was at about this time that the plants were received from St. Helena at Chelsea, which Haworth recognized as being his own *A. angustifolia.*

His Excellency, the present Governor of St. Helena, has obligingly had Mr. T. Broadway, Clerk of the Works, send me leaves, capsules and seeds of the common fence aloe of today, which I cannot distinguish from *Agave Wightii* of Barbados, *A. excelsa* of the La Mortola Garden, *A. lurida* [Jacq.] as collected by Engelmann in the Naples Garden, or a plant cultivated formerly in the Missouri Botanical Garden as *Fourcroya rigida*,‡ under which name seed had been bought in Europe by Mr. Shaw somewhere about 1858, Engelmann considering the plant to be *A. angustifolia*, and Baker—without excluding this possibility—naming it first *A. Ixtli* and afterward *A. excelsa.* Mr. Broadway further calls attention to the fact that this fence aloe is referred to in Melliss' History of St. Helena under the name *A. lurida* Jacq. Through the further kindness of the Governor, I have learned that Mr. Homagee, one of the old residents of St. Helena, remembers having been told in his youth that Agaves were taken to that island from Buenos Aires in 1806, by Captain Robert

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* Tracts relative to the island of St. Helena. London

† Hooker, Lecture on insular floras. London. 1896. p. 18-19.

‡ It will be recalled that Koch found nothing except *angustifolia* under the name *rigida* in 1860, although he enters *rigida, angustifolia* and *Jacquiniana* in sequence in his monograph of that year.

Wright, and that a sample of aloe fiber was submitted to the insular government and transmitted to England in November, 1809;—but it is not clear that *americana* is not referred to.

The history of *A. Jacquiniana* at Kew (on which Mr. Baker's description of *A. excelsa* seems also to have been based) makes Central America the probable home of *Agave angustifolia*. No evidence appears as to the date or manner of its introduction into India or the West Indian island of St. Vincent; but the omission of anything that could pass for it from the books of Hughes (1750), Maycock (1830) and Schomburgk (1848) indicates that it is of rather recent introduction into Barbados, where, like *Yucca aloifolia*, it is called Spanish needles. Its synonymy is as follows:

AGAVE ANGUSTIFOLIA Haworth, Syn. Pl. Succul. 72. (1812); 78. (1819); Revis. Pl. Succul. 35. (1821).—Link, Enum. Berol. **1**: 334. (1821).—Steudel, Nomencl. 18. (1821); 2 ed. 36. (1841).—Sprengel, Syst. **2**: 79. (1825).—Schultes, Syst. **7**[1]: 727. (1829).—Herbert, Amaryll. 128. (1837).—?Bojer, Hort. Maurit. 353. (1837).—Don, Sweet's Hort. Brit. 3 ed. 704. (1839).—Dietrich, Syn. Pl. **2**: 1192. (1840).—Roemer, Ensatae. 291. (1847).—Kunth, Enum. **5**: 837. (1850).— Koch, Wochenschr. Ver. Beförd. Gartenbau. **1860**: 48; **1865**: 101; Fl. des Jard. **1861**: 147; Belg. Hort. **1862**: 309.—?Rept. Internat. Hort. Exh., London. 296. (1866).—?Ellemeet, Belg. Hort. **1871**: 121.—?Hanbury, Gard. Chron. n. s. **20**: 54. (1883).—Drummond & Prain, Agric. Ledger. **1906**: 88.—Trelease, Wiesner-Festschr. 336. (1908).

A. augustifolia Peacock, List. 3. (1878).

?*A. rigida angustifolia* Kew Hand List Tend. Monocot. 119. (1897).

?*A. lurida* β Aiton, Hort. Kew. **1**: 472 (1789).—?Willdenow, Sp. Pl. **2**: 194. (1799).—Aiton fil., Hort. Kew. 2 ed. **2**: 302. (1811).—Poiret, Encycl., Suppl. **1**: 240. (1810).—Schultes, Syst. **7**[1]: 726. (1829).

A. lurida Jacquin, Obs. Bot. **4**: 94. *pl. 1.* (1790).—Targioni Tozzetti, Ann. Mus. Imp. Firenze. **2**[2]: 25, 31-5. *pl. 6.* (1810).—Beatson, Tracts on St. Helena. 296. (1816).—Bertoloni, Giorn. Acadico. **21**: 189. (1824).—Steudel, Nomencl. 2 ed. 36, (1841).—Salm, Bonplandia. **7**: 90. (1859).—?M[orren], Belg. Hort. **1863**: 249.—

Melliss, St. Helena. 336. (1875).—Forbes & Hemsley, Journ. Linn. Soc. Bot., **36**: 90. (1903).—Drummond & Prain, Agric. Ledger. **1906**: 123. 127.

A. pyramidalis Salisbury, Gen. Pl. 79. (1866).

A. Jacquiniana Schultes, Syst. **7**[1]: 727. (1829).—Roemer, Ensatae. 284. (1847).—Kunth, Enum. **5**: 827. (1850).—Hooker, Bot. Mag. iii. **15.** *pl. 5097.* (1859).—Gartenflora. **8**: 273. (1859).—Belg. Hort. **1859**: 265. *f. 25.*—Journ. d'Hort. Prat. **1859**: 75.—Salm, Bonplandia. **7**: 87. (1859).—Koch, Wochenschr. Ver. Beförd. Gartenbau. **1860**: 48; Fl. des Jard. **1861**: 147; Belg. Hort. **1862**: 310.—Jacobi, Hamburg. Garten-Zeit. **1864**: 460, 461, 501; **1865**: 158; Versuch. 7, 8, 17, 96. (1865).—Ellemeet, Belg. Hort. **1871**: 118.—Haage & Schmidt, Cat. **1873**: 14.—Garden, **3**: 390. (1873).—Peacock, List. 3. (1878).—?Dodge, Rept. Fiber Invest. U. S. Dept. Agr. 5: 43. (1893).—Hayn, Gartenfl. **43**: 515. (1894).—Drummond & Prain, Agric. Ledger. **1906**: 140.

A. Jacquinii Salm, Bonplandia. **7**: 95-6. (1859).—Gard. Chron. n. s. **3**: 662. (1873).

A. lurida Jacquiniana Salm, Wochenschr. Verein Beförd. Gartenbau. **1861**: 179, 181; Fl. des Jard. **1862**: 118. 123.—Baker, Gard. Chron. n. s. **8**: 264. (1877); Handb. Amaryll. 183. (1888).—Hemsley, Biol. Centr.-Amer. **3**: 345. (1882-6).—Voss & Siebert, Vilmorin's Blumengärtn. 1037. (1896).—Watson, Gard. Chron. iii. **21**: 166. (1897).—Kew Hand List Tend. Monocot. 115. (1897).—Nicholson, Dict. Suppl. **1**: 28.—Braun, Der Pflanzer. **2**: 225. (1906).

A. lurida Iacquiniana Terracciano, Primo Contr. 43. (1885).

A. Vera Cruz Jacquiniana Ascherson & Graebner, Synops. Mitteleurop. Fl. **3**: 417. (1906).

? *A. ixtlioides* Hooker, Bot. Mag. iii. **27.** *pl. 5893.* (1871).—Gartenflora. **1871**: 212.—Fl. & Pomol. **1872**: 3.—Gard. Chron. **1872**: 505.—Baker, Gard. Chron. n. s. **8**: 397. (1877); Handb. Amaryll. 181. (1888).—Ricasoli, Bull. Soc. Tosc. Ort. **3**: 241. (1878).—Hemsley, Biol. Centr.-Amer. **3**: 348. (1882-6).—Terracciano, Primo Contr. 44. (1885).—Rose in Bailey, Cyclop. Amer. Hort. **1**: 34. (1900).—Nicholson, Dict. Suppl. **1**: 28.

? *A. flavovirens* Jacobi, Hamburg. Garten-Zeit. **1866**: 270; Versuch. 258.—Trelease, Rept. Mo. Bot. Gard. **18**: 236. (1907).

A. flavoviridis Jacobi, Nachtrag. 2: 75. (1871).

? *A. excelsa* Jacobi, Hamburg. Gart.-Zeit. **1865**: 567; **1866**: 215; Versuch. 197, 238.—Rept. Intern. Hort. Exhib., London. 296. (1866).

A. excelsa Baker, Gard. Chron. n. s. **8**: 397. (1877); Handb. Amaryll. 182. (1888).—Ricasoli, Bull. Soc. Tosc. Ort. **3**: 241 (1878).—? Pea-

cock, List. 2. (1878).—Hemsley, Biol. Centr.-Amer. **3:** 342. (1882-6). —? Kew Hand List Tend. Monocot. 111. (1897).—Segura, El Maguey. 4 ed. 96. (1901).—? Cat. Tender Pl. Fairmount Park. 5. (1907).

A. Ixtli excelsa Terracciano, Primo Contr. 44. (1885).

A. rigida De Spin, Jard. St. Sebast. 23. *pl. 1.* (1812).—Salm, Bonplandia. **7 :** 90, 95. (1859); Wochenschr. Ver. Beförd. Gartenbau. **1861 :** 179; Fl. des Jard. **1862:** 118, 123.—Jacobi, Hamburg. Garten-Zeit. **1864 :** 460, 461, 500; **1865 :** 156; Versuch. 6, 8, 16, 94; Nachtrag. 8. (1867).

A. rigida var. Hart, Rept. Trinidad Gard. **1890,** *fide* Gard. Mag. **35 :** 160.—Kew Bull. **1892 :** 35; **1893 :** 280.

A. rigida elongata Bull. Grenada Gard. 30 : 285. (1893).

A. Wightii Prain, Proc. Agr.-Hort. Soc. Madras. **1904 :** 130, 137; **1905 :** 38, name only.—Drummond & Prain, Agric. Ledger. **1906 :** 78, *91*, 102, 105, 128, 139, 140, 147. (1907).—Braun, Der Pflanzer. **2 :** 232; **4 :** 87.—Cooke, Fl. Presid. Bombay. **2 :** 753. (1907).—Drummond, Rept. Mo. Bot. Gard. **18 :** 27. (1907).—Queensland Agric. Journ. **19 :** 319. (1907).

A. vivipara Buchanan, Journey. 36. (1807), *fide* Drummond & Prain.—Wight, Icon. Pl. Ind. Or. **6.** *pl. 2024.*—Hooker, Fl. Brit. Ind. **6:** 277. (1894).—Kew Hand List Tend. Monocot. 123. (1897), at least in part.—? Trimen & Hooker, Handb. Ceylon. **4 :** 268. (1898).—Woodrow, Journ. Bomb. Nat. Hist. Soc. **12 :** 522. (1899).

A. vivipera Wight. *l. c.* 18.

? *A. procumbens* Jameson, Cat. Saharanpur. 1855,—*fide* Drummond & Prain

? *Fourcroya rigida* Tornabene, Hort. Bot. Catania. 211. (1887)

Other uses of the name *A. angustifolia* are:—

A. ANGUSTIFOLIA J. & Hort. Paris.

Furcraea tuberosa Ait.?—See Drummond, Rept. Mo. Bot. Gard. **18 :** 59, 60.—With this is to be compared the scarcely-known *Agave stenophylla* Jacobi, which had originally come from Paris as *A. angustifolia* and the resemblance of which to *Furcraea* was recognized by Jacobi when he named it (Hamburg. Gart.-Zeit. **1866 :** 269; Versuch. 257).

A. ANGUSTIFOLIA de Fonvielle, Rev. Hort. **1861 :** 415.

A. collina Greenman ?,—the seeds having been collected by Roezl at Tasco.

A. ANGUSTIFOLIA Schott, Agric. Rept. **1869 :** 258.—Mairaux, Agaves Textiles. Revue Américaine. Apr. 15, 1904.

A. Ixtli Salm,—the "chelem" of Yucatan.

A beautiful form of this species with white marginal variegation and decurrent silver-gray lines, which appears to have

been found in Indian gardens about 1892 (the *A. angustifolia variegata* of French gardens some thirty years earlier perhaps having been *A. picta*), is now frequently cultivated under the name *A. vivipara variegata*.* A rare sport of this variety, which originated in the botanical garden of the College of Science at Poona about 1895, has been called by Mr. Watson *A. Woodrowi* after its discoverer, who himself called it *A. Cookei*. This distinct horticultural form, which possesses the white marginal variegation in unusual width, has the remaining leaf surface silvery gray or milky, like the submarginal stripes of the original variety—the chlorenchyma being everywhere overlaid by several layers of etiolated cells.†

EXPLANATION OF PLATES.

Plate 29.—*Agave rigida*.—A reduced photographic copy of Commelin's illustration of "Aloe americana ex Vera Cruce foliis angustioribus minus glaucis," in Hort. Amstelodam. Rar. Plant. Descr. et Icones. **2.** *pl. 17.*

Plate 30.—*Agave angustifolia*.—A reduced photographic copy of Targioni Tozzetti's illustration of *Agave lurida* in Ann. Mus. Imp. Firenze. **2^2.** *pl. 6.*

Plate 31.—*Agave angustifolia*.—Leaves of *Agave lurida* as grown today for hedges in St. Helena, × ½. Broadway material.

Plate 32.—*Agave angustifolia*.—Leaves, capsules and seeds of the *Agave lurida* of St. Helena, natural size. Broadway material.

Plate 33.—*Agave angustifolia*.—Flowers of *Agave lurida* as represented in Jacquin's herbarium at the Vienna Hofmuseum, natural size. Photographed in 1905, by permission.

Plate 34.—*Agave angustifolia*.—Flowers and leaf detail, natural size, of *Agave excelsa* Baker; the former from material pressed at La Mortola by Mr. Berger in 1905, the latter from a fresh leaf received from Mr. Berger in 1907.

Plate 35.—*Agave angustifolia marginata*.—Young leaves. At the right, the typical variety; at the left, the form *Woodrowi*, natural size. From Kew material, communicated by Col. Prain in 1908.

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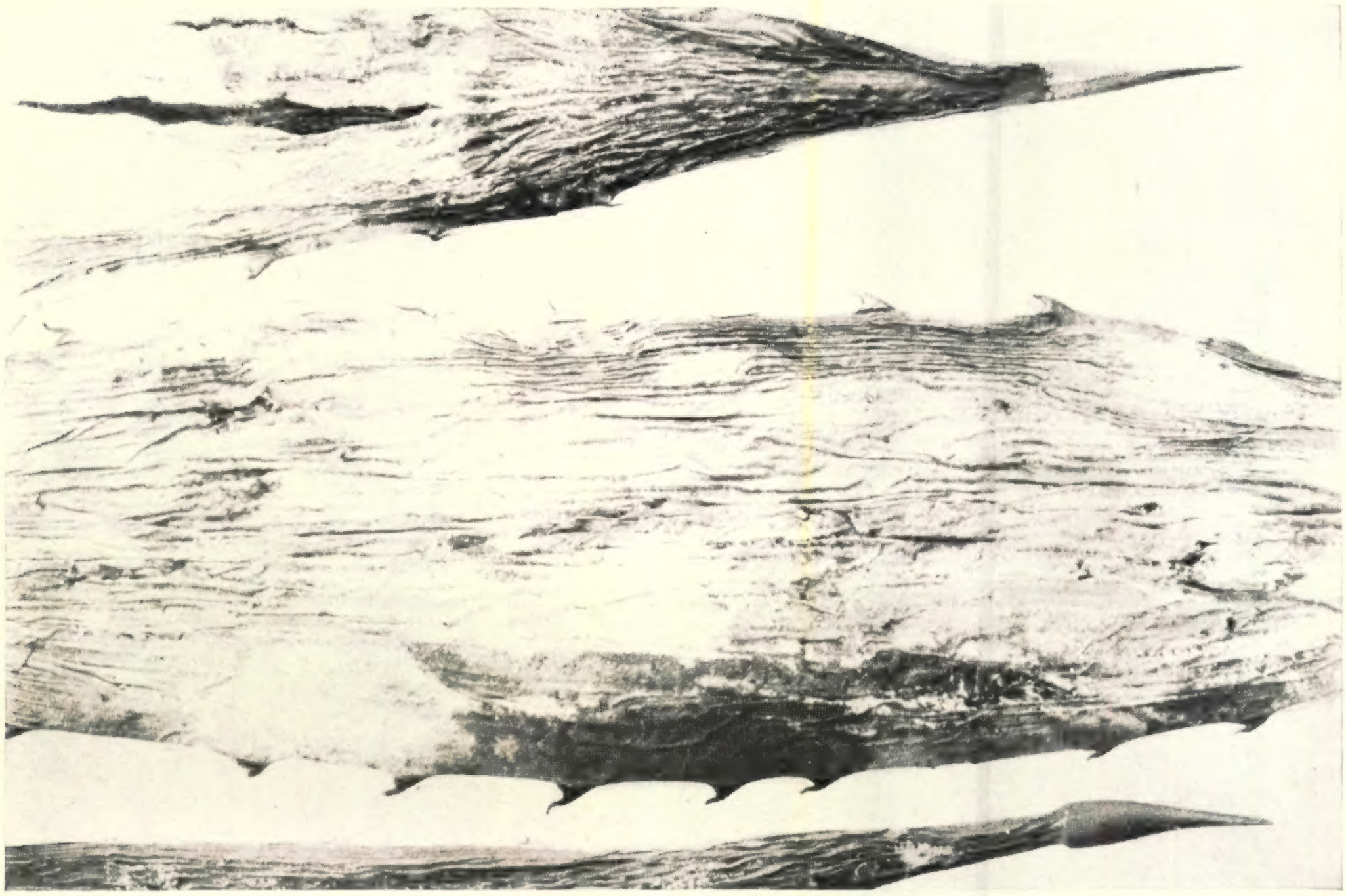
* *A. angustifolia marginata* Trelease, Wiesner-Festschrift. 343. *pl. 8.* (1908).—It also occurs in the Singapore garden under the name *A. superba*.

† This may be known as *A. angustifolia marginata Woodrowi*, with the synonymy *A. vivipara* var. nova, *A. Woodrowi* and *A. Cookei* of the Wiesner-Festschrift account.

AGAVE RIGIDA.

AGAVE ANGUSTIFOLIA

AGAVE ANGUSTIFOLIA.



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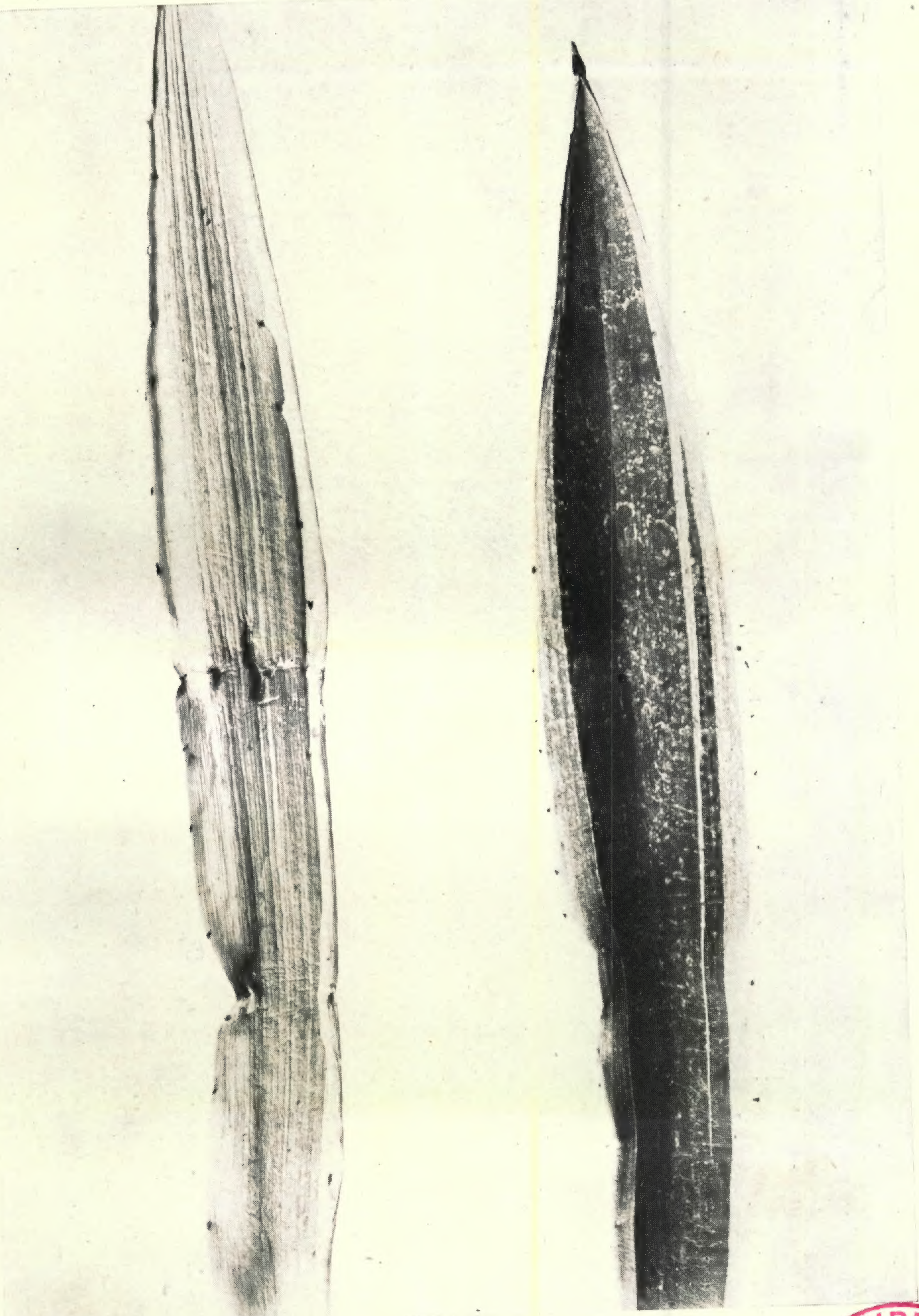

AGAVE ANGUSTIFOLIA MARGINATA.

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